AMATEUR WORK

A MONTHLY MAGAZINE OF THE USEFUL ARTS AND SCIENCES

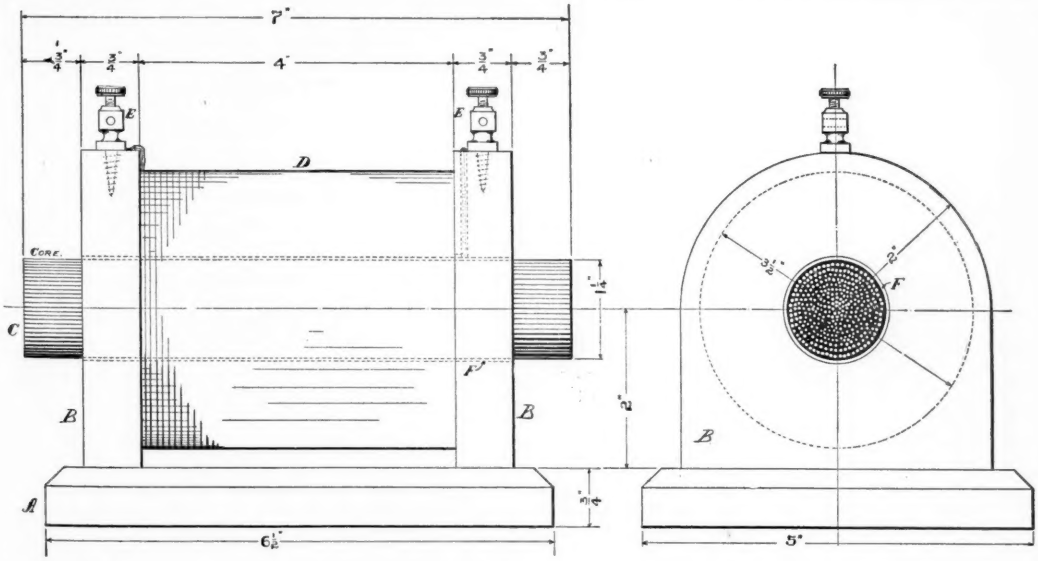
Vol. III. No. 2. BOSTON, DECEMBER, 1903. One Dollar a Year.

GAS ENGINE SPARK COILS.

ALBERT GRAHAM.

I. Coils for "Make and Break" Type of Igniters.

Two methods of electric ignition are in general use to explode the compressed charge behind the piston of a gas or gasoline engine. These are commonly called the "make and break" spark method and the "jump-spark" method. Of these two perhaps the "make and break" contact method will give the most general satisfaction, although to make a positive assertion on this point is to assume a great deal, since the jump-spark method allows of great latitude in instantaneous adjustment, known as "timing," by means of which the explosion is made to occur at different points of the stroke. The principle difficulty with the former method is the rapid deterioration of the sparking points due to the pitting caused by the spark, while on the other hand the spark-plug used in the jump-spark method occasionally becomes covered with soot (unburned carbon deposited after the explosion and caused by insufficient air being mixed with



the gas or gasoline vapor, thus preventing complete combustion) which short circuits the current, on the other hand the oil used in lubricating the cyclinder is sometimes deposited on the sparking terminals of the plug and burned on as a glaze by the heat. This forms an effectual insulating medium through which the spark may be unable to penetrate owing to the increased resistance.

In order that a spark may pass between any terminals separated by an air gap, it is necessary that the tension of the current be raised to such a point that the resistance of the intervening layer of air will be overcome, and the current passing across will heat the suspended matter into a highly incandescent state which gives rise to the spark.

If we join to the terminals of a cell two wires and complete the circuit by joining the free ends, we will notice that a small spark is formed when the ends are suddenly separated. Suppose we now include in the circuit an electric bell, when the bell is ringing sparks of considerably larger size will be seen at the vibrating armature spring contact, even with the same cell as before. Now this increase in the size of the spark is caused by the effect of the magnets in the following manner.

When the bell is in a passive state and the current is first turned on by pressing a button or other means of closing the circuit, the magnets do not instantly acquire their full strength, but require a very short interval of time to "build up." When this state is reached they attract the armature, thus breaking the circuit. But the lines of magnetic force which are at this time coursing through the magnet cores and armature do not cease immediately, and it is the cutting of these lines of force by the coiled conductors (wire) as they fall from their maximum value to zero that generates sufficient tension to make the spark jump the gap between the terminals. It is, in fact, as if the current possessed inertia which required the application of an external force to bring it to rest.

Now this is exactly why a spark coil is provided for a gas engine with contact points that are suddenly separated. It consists of a core of soft iron wires closely bound together and surrounded by a coil of insulated magnet wire of many tnrns. The core is built up of small wires because it makes a much stronger magnet, due to various reasons that need not be discussed at present.

To make this core, it will require 2 ½ lbs. of No. 14 soft iron wire, cut into lengths of 7″. About 250 pieces will be required. When all are cut, bundle them together as closely as possible and wrap firmly with small steel or iron wire. Lay a piece of thin sheet iron over a good bed of coals in a stove and upon this place the bundle, leaving it there until the entire mass is brought to an even cherry red heat, not too bright. Then by means of a pair of tongs place the red hot bundle just on the top of the fire brick where it will cool very slowly, pushing it back further and further from the coal pit at intervals of about half an hour. This will serve to thoroughly anneal the wires and give them a high permeability.

After they are cooled off at the back of the stove, bring them into the air and allow to cool to the temperature of the room. Then bind the ends firmly so that the first binding wire may be removed. Now begin to wrap the bundle with a strip of foolscap paper cut into strips 5 ½″ wide, cementing it in place with shellac. When a layer about $\frac{1}{16}$″ is laid on, tie a thread around it to keep it from unrolling and bake in a warm oven until perfectly hard. This paper tube will serve to keep the wires in place but the binding wires now on the ends must not be removed entirely until the coil is finished.

Cut out the base from cherry or some other hard wood, making the coil ends *B-B* of the same stock. Bore a hole in each end as shown so that it will just go over the paper tube. Force the ends on and secure by a little shellac, after making both bases parallel so that they will each lie flat on the base *A*. The binding wires on the ends may be temporarily removed while these ends are being put in place, but should be replaced immediately thereafter.

Now find the centre of the iron wire core *C* with a pair of dividers, and drill a small hole in each end, countersinking for the lathe centers. Swing the spool on the centres and drive either by a clamp-dog or a piece of wire wrapped around the core end and then fastened to the face plate. The binding wires on the core ends will prevent the pressure of the tail centre spreading the wire.

One of the spool ends has a vertical hole drilled

from the top to the center which accommodates the end of the inside layer of wire. Pass the wire through this hole before beginning to wind leaving enough protruding to attach to the binding post *E*. Wind the space between the ends full of No. 18 single cotton covered magnet wire, which will require about 6 $\frac{1}{4}$" pounds. Secure the end of the last layer to the other binding post. These binding posts should have a wood-screw end which can readily be screwed into place and exert a good pressure on the bared end of the wire beneath them, thus preserving a good contact. Give the last layer two or three good coats of shellac varnish, allowing each to dry in an oven before applying the next. This will serve to exclude moisture from the coils. A layer of cord may be wrapped on outside of this if desired, which, when stained black with india ink or shoe-polish, dried, and polished with wax makes a very handsome finish.

Mount the spool on the base by four screws passing through it and finish by giving two coats of varnish. This coil should be connected in series between the battery and the sparking device of the engine. It is very strong and will give a good fat spark if the connections are well made. A word of advice to those fitting ont gasoline or gas engines with a make and break contact ignitor. Do not attach one terminal to one end of the spark plug and the other to some remote part of the engine frame where the current will have all the extra resistance of the metal, frame joints and dirty, oil-begrimed bearings of the other vibrating contact point to pass through. Drill a hole into the end of the moving or osciliating pin and tap it so that it will take a binding post. Then make your other connection to this post, wrapping the wire once or twice around the shaft or even the binding post itself, tying it there with thread or another wire. This will allow the wire to bend with the movement of the shaft and not be broken off. The amateur will find that this method will give him less trouble than the ordinary method, his spark will be better for the lower resistance, and with proper care the connecting wire need not be broken by the vibrations. This one point in particnlar is where fully half of the present day engine troubles lurk.

The jump-spark coil will be described in the next number of Amateur Work.

MICROSCOPY FOR AMATEURS.

S. E. Dowdy. M. P. S.

Leaving this brief outline of the instrument's history, we will presume the reader unacquainted with microscopy and on the lookout for a microscope, and trust that the following suggestions as to the selection of a suitable one may give the chooser some idea of what to expect and what to avoid.

In the first place, the beginner should clearly bear in mind that the real benefit to himself and science derived from his taking up microscopy as a hobby will depend more on his own efforts than on the cost of the instrument. Leenwenhoek, with his crude single lenses fastened in metal plates, made observations and recorded details which the modern scientist with his carefully corrected compound lenses cannot dispute or even n some cases enhance; and this is mentioned not to disparage modern instruments or methods, but simply to point out that care and patience can accomplish much, even when handicapped with inferior tools.

The choice of an instrument must necessarily be governed by the length of the purchaser's purse; but the average cost of a good working microscope for students' use may be taken as about $25. They can be obtained for as low as $10, or even less, second-hand. The beginner, however, is strongly advised not to purchase a second-hand instrument, unless it is a recent model by a well known maker, as unless he can obtain a friend's advice on the subject he may find himself burdened with an old-fashioned type of stand, with obsolete fittings and adjustment.

So rapid have been the advances and improve-

ments in the cheaper forms of microscope of late years that the better plan, if unacquainted with the subject, is for the beginner to put himself entirely into the hands of a good dealer, stating what he feels disposed to invest in the purchase of one, and relying on the dealer's honesty to supply him to the best of his ability.

In purchasing either a new or second-hand instrument, above all things do not be carried away by the glamor of lacquer and highly polished metal; in fact, don't judge a microscope by its appearance, only from its performance. Lacquer cost little, careful workmanship in fitting and adjusting a lot, and the fine qualities are not always found in the same microscope. The general appearance of the microscope is, from its frequent appearance in optician's windows and similar situations, tolerably familiar as far as its external features are concerned, so that a description is not necessary. Though similar in their general appearance, microscopes may really be divided into three classes. There is, for instance, the full sized instrument, replete with every convenience that experience can suggest and wealth and skill provide. Then, again, there is the smaller edition, shorn of most of the mechanical conveniences found on the larger stands. It is with this class of microscope, generally known as the Student's, that we have to deal. Lastly, there are those microscopes which to all intents and purposes are merely toys, useless for either recreation or study. I am glad to say they are mostly importations from the Continent, their low cost being only equalled by their inferior performance. These must not be confounded with the products of such houses as Zeiss, Leitz, etc., whose work is certainly equal to some of our best opticians, though their models may not be quite so well designed. We must not forget, too, that we are indebted largely to them for improvements in the cheaper lenses now on the market. Large instruments are not suitable, and are too costly for the average amateur, their chief advantage being that they will give a larger field of view than the students' instrument, and this is not always the advantage that might be expected.

Before actually purchasing the microscope, it would be well to bear in mind some of the characterics of a good instrument for student's use. It should be simple in construction, compact, and sufficiently heavy to insure the necessary stability. Its adjustment must work smoothly and be conveniently situated both for working purposes and for repairing if necessary. Its fittings must be of standard size, and the stand, as the instrument minus its lens is termed, should be capable of taking the accessory apparatus required from time to time in microscopical work. Providing its lenses are up to the mark, an instrument having the above qualifications can be relied upon for all ordinary purposes. Before proceeding to test its adjustments, it will be as well to briefly indicate the parts which go to make up a complete stand. First of all comes the *Base*. This will probably be either the Continental form, which consists of a heavy horsehoe-shaped piece of metal surmounted by a thick brass pillar, on which the rest of the instrument is jointed, or else the English form of foot, which is a tripod, the spread given to the feet insuring the stability, which in the Continental form is mainly secured by the weight of the horsehoe. The chief advantage of the Continental form is its compactness; but if desirous of taking up photomicrography or drawing with the camera lucida, the student is advised to choose the tripod base, the only objection to it being that an instrument fitted with it requires a rather larger cabinet. Most microscope bases are made after these two models, or slight modifications of them.

Next comes the *Mirror*. This should be double, plane on one side and slightly concave on the other, and so fitted that it can be slid nearer and away from the object. Usually it is mounted on a swinging arm, so that oblique illumination may be obtained, as the fine details of an object may sometimes be made out when direct axial light fails to reveal them, if the illuminating pencil of rays of light be sufficiently oblique.

We now come to a most important part of the stand — viz, the *Substage Condenser*. This may or may not be present, it all depends upon the original cost of the instrument. In its simplest form it consists of two lenses, mounted in a short fitting. The lower lens is rather large, double convex, and serves to collect divergent rays from the mirror and transmit them through the upper lens, which is smaller and plano-convex, with the plane surface next the microscope stage. The chief purpose of the substage condenser is to pro-

vide brilliant illumination of an object when using high-power objectives. Incidentally, the image is improved by the illuminating rays being brought to a focus and concentrated on the object, the resultant image being more sharply defined than if light from the mirror alone without any condensing system was being employed. If purchasing a new stand, insist on having one either provided with a substage condenser, or else a fitting capable of taking one at some future time, as they may be purchased separately at any time. If this is out of the question fit in an improvised substitute, as a microscope nowadays can hardly be called such if unprovided with such a necessary adjunct.

The Stage, as the flat plate on which the slides are placed for examination, is termed, will now require a short comment. In students' microscopes it is simply a metal plate, with either a circular or horsehoe-shaped opening, on each side of which is a spring clip for holding down the slide. Better class microscopes have mechanical stages where motion is imparted by rotating milled heads, but as these require very skilled labor in fitting and adjusting, they cannot very well be added to a cheap instrument. The addition of a sliding bar to the ordinary stage is an improvement, and can be obtained to fit nearly any make of stand. If the microscope is not fitted with a substage condenser, it should have a metal plate, furnished with circular apertures of varying diameters, to revolve just under the stage aperture. This arrangement is called the diaphragm, and is used to cut down the amount of light thrown up by the mirror. Very transparant objects with delicate detail are quite obscured if too much light is being used, and this is where the diaphram is useful.

The *Body-tube* next requires a little discription. Two lengths are adopted nowadays by the makers; viz., 6 inches for students' instruments, 10 inches for their larger stands. It is important to note the difference because objectives are corrected nowadays for either one tube length or the other, and it is necessary, if the highest excellent of definition be desired, that a lens should be used on that particular tube length, for which it was originally corrected and intended. If possible, get an instrument the body-tube of which is fitted with a draw-tube; a short length of tubing, the upper end carrying the eyepiece, and sliding up or down in the main tube. The draw tube is a most useful edition to a microscope as increased magnification is obtained by its use, and if a student's pattern instrument, objectives for both 6 in. and 10 in tube lengths can be used on the same stand by simply closing up or pulling out draw-tube. The diameter of the main tube may also vary. Student's stands take an eye piece of about .92 in. diameter, the large English stands 1.07in. Unfortunately, all eye pieces are not made to exactly the same gauge, as in the case with objectives mounts, so that it is as well to purchase the eyepieces from the same maker who supplied the stand.

Focussing Adjustments will now claim our attention. These, as a rule, are two in number, and are known as the coarse and fine adjustments. The former, as its name implies, is for the purpose of obtaining a rough or approximate focus, the latter for getting the correct adjustment necessary to obtain a sharp picture of the object. Coarse focussing may be accomplished by either sliding the body-tube up and down in a cloth-lined collar, this method being adopted in the cheapest stands, or a preferable method being that where a rack and pinion adjustment is substituted, whereby a more delicate motion may be imparted to the tube. It is, however, well worth the extra expense to have the rack and pinion adjustment, which if good, will enable the student to do all his focussing, except when using his highest power lens. The fine adjustment, by the aid of which an almost inappreciable movement may be imparted to the optical system in the microscope, is one of its most indispensible adjuncts. High-power work would be quite impossible without its help, so sensitive are modern high-magnifying objectives to the slightest alteration of their distance from an object. The necessary motion is imparted by rotating a milled head, which in its turn actuates a lever or rotates a screw, different makers adopting different methods to accomplish the same end. As it is important that both coarse and fine adjustments should be of first-class workmanship, their behavior will be noticed when we are testing the lenses supplied with the microscope.

English Mechanic.

CONTINUED IN THE JANUARY NUMBER.

JUDGMENT IN MOUNTING PRINTS.

FRANCOIS VOITIER.

A chain is as strong as its weakest link, no stronger. One defective and eleven perfect links form a chain of no greater resisting qualities than should the entire twelve be imperfect. Every link demands equal care and attention in its manufacture, each contributes its share towards the perfection and usefulness of the whole.

Finished photographs can well be likened unto a chain, the links being designated as exposure, development, fixation, printing, trimming, mounting and framing. None of these several processes can be neglected without detriment to the perfection of the completed product, indifference or carelessness in the moulding of any one link in the photographic chain will not fail to detract from the beauty of the picture in toto.

These are facts, but I hardly think their full significance is appreciated by a good many amateur workers. After exercising reasonable diligence in taking care of the exposure and development of a plate or film and taking off a print therefrom, is it not true that the important requirements in the making of a picture are considered as having been complied with, little (if any) attention being paid to the balance of the links in the belief that they occupy a place of secondary importance? The link "mounting," is it not regarded as having little bearing upon the beauty and strength of the finished picture? Both these queries demand an affirmative answer. Let me assure you that tens of thousands of good prints are annually ruined by injudicious mountiug; further, that it is well within the range of possibility to greatly improve an indifferent print (sometimes a really bad one) by keen discrimination in the use of the trimming knife and the selection of the mount. Such, in a few words, is the importance of these links.

The purpose of mounting is to give a picture a "finish," accentuate any good points it may have and so enhance its beauty and value. Unless the mount does this, nothing is gained, in truth, very much is lost, and it would have been far better to have left the photograph in an unmounted state. Any mount is unsuitable which attracts more attention than does the picture itself. The picture must ever remain the centre of interest and a card of such color, shape, design or size as completely conserves this end is the only and proper one to use. Except by the advanced artist-worker, double mounting, that is a card pasted on a card, is rarely successful when two or more different colors are to be introduced. The practice should certainly not be attempted by the beginner. It is a sign of weakness either to mount a picture in a certain way for no other reason than that someone else has done it, or to mount in a certain way for no other reason than to be different from anybody else. Either of these methods, however, is admissible if carried out in the proper spirit, which might be described as the keeping in mind of the object as a sole and only guide. The bizarre is invariably out of place mainly because the motive which prompts it is not good. Eccentricity is not art, neither is art eccentricity.

The simplest, best and most comprehensive rule to remember in connection with mounting is the one whose key note is harmony. Every photograph has a dominating tint of color, and a continuation of this master tone in the mount will result in a effect both pleasing and artistic. In this way the mount is made to appear as part and parcel of the picture rather than to be intent on stirring up strife one against the other. Combinations whose elements are in a state of civil war are an offense to the eye for the beautiful, the harmonious and the artistic.

Carbon black and the various shades or gray lend themselves admirably to any of the black and white papers, bromide, gaslight and platinum. Green-black and brown-black mounts are useful for prints where the blacks are impure, as is often the case. This degrading of the blacks may either be intentional or purely an accident. Pigment and gum tones call for cards of more positive colors. It would be useless to attempt an enumeration of suitable mounts corresponding to all the tones obtainable in a print, their name is

legion. In any event, to do this would simply put you in a position akin to that of an automaton powerless to follow a course other than that prescribed by a complicated system of internal mechanism.

When all is said, though, the selection of mounts for our pictures is a matter which rests largely with the taste and judgment of the individual; but it would seem to me that the individuality reflected in some of the color combinations that have come to my notice is far too immature and insincere to be identified with any thoughtful and artistic worker. A "personal element" of this description should be found wandering around in search of an owner with no claimants in sight. *Camera and Dark Room.*

GAMES FOR CHRISTMAS.

JOHN F. ADAMS.

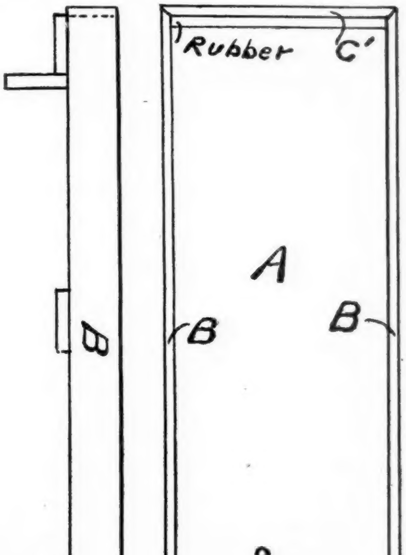
The approach of Christmas, and the accompanying discussion relative to presents for boys, recalls the making of a few games which would be particularly suitable for presents, are easily made at small expense, and would afford much enjoyment to both young and old, so here they are: —

CARROM BOWLING ALLEY.

A particularly desirable feature of this alley is, that the pins and shooting point are both at the same end of the board, thus avoiding the necessity of constantly moving to the other end to set up the pins and recover the balls. For that reason it is attractive to a single player.

The bottom *A*, of white-wood is 48″ long, 15″ wide, and ¾″ thick and should be planed on a surfacing planer to ensure that all wind or uneven places are taken off. Four oak or maple cleats 14″ long, 4″ wide and ⅞″ thick, are then screwed across the under side to keep the surface of this board perfectly true, one 2″ from one end, one 6″ from the other end, and the two others equally spaced between or about 11″ apart. The bottom board is then cut out at the end on the end *C* to form a pocket by sawing off a piece 5″ with the length and 12 ¼″ across, leaving a projection 3″ wide and 5″ long. Save the piece cut off to use for the bottom of the pocket. Two side pieces *B* 49 ½″ long, 3 ¾″ wide and ¾″ thick and two end piects *C* and *C′*, 16 ½″ long, *C′* 3 ¾″ wide and *C* 8 ½″ wide and ¾″ thick, are then firmly screwed to the sides and ends, the joints being mitred. The wider end piece *C* is for the end with the pocket.

A piece *D* 12″ long, 4 ¾″ wide and ¾″ thick is then screwed to the inner cross edge of the pocket, the edge being just flush with the bottom board.



Two side pieces *E*, the outer one 6 ½″ long, and the inner one 5 ¾″ long, 4 ¾″ wide and ¾″ thick, are then fitted to the sides of the pocket. The outer piece has mitred corner at the joint with *C*, but laps over on piece *D*. The inner one laps

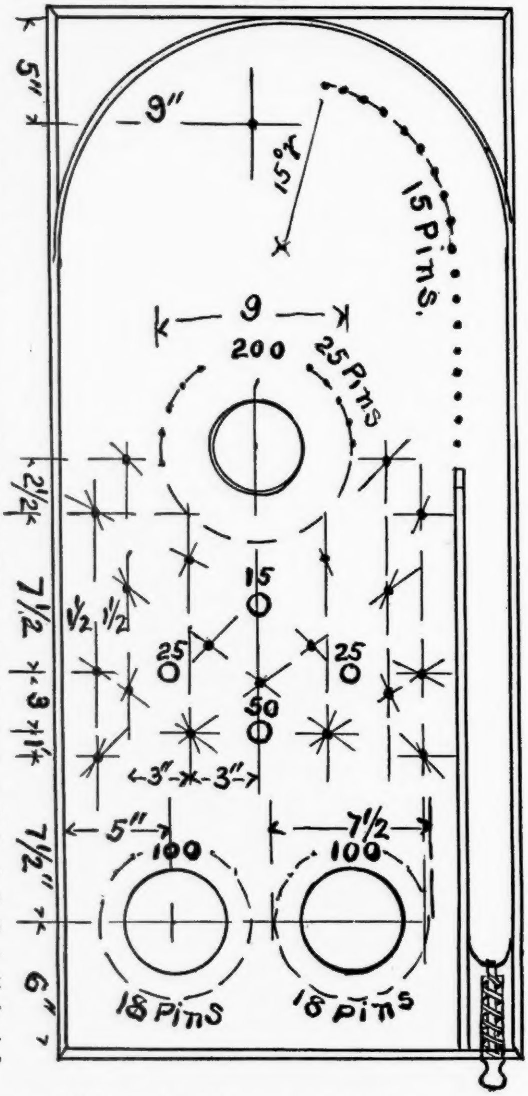
on *D* and is fastened to *C* and *A* by screws put through from the outside, the heads of all screws being deeply countersunk. It will be noted that the inner piece *E* projects into the pocket ¼″, the space above it being filled by the partition. The joint between *E* and *B* would look best if glued, but if carefully fitted this need not be done, as there is ample strength without. The bottom board is then put in and nailed firmly with wire nails through *C*, *D* and *E*.

The partition board *F* is 7″ long, 3 ¾″ wide and ¼″ thick, the inner end being cut to an angle of 20°, and also cut away on the under edge to fit over the board *A* where it projects beyond the pocket. It is fastened by nailing along the lower edge to *A*, at the end to *C* and a nail on the other end drawn into *A*. Two legs 4 ¾″ x 2″ x ¾″ are screwed to the cleat, at the *C′* end, to level the board.

A strip of rubber ¾″ wide and ½″ thick is then glued along the inside of *C′* for a cushion for the ball; a piece of a carriage tire, packing or other form, if the kind used on billiard tables is not easily obtained. A set of ten pins about 4″ high is the most suitable size. A large glass marble or small billiard ball is the most suitable for the ball. If stained in mahogany, varnished and brass trimmings put on the corners, it will have quite an attractive appearance. A small moulding with a flat top can also be added to the upper outside edge. The bottom and sides of *B* and *C* are covered with green baize or felt. The pocket is thickly padded with cloth before covering, a piece of pile carpeting being best for the purpose, and generally obtainable for the asking from the waste pieces of a carpet store. The location for the pins may also be indicated by red paper seals. A billiard cue completes the outfit. In use the board is placed upon a level surface, the ball is driven from the little alley at the side of the pocket to the rubber cushion, and carroms back against the pins, counting being the same as for regular bowling. It will be found a matter requiring considerable skill, to make good "strikes," and a decidedly interesting game to play.

BAGATELLE BOARD.

The general construction of this game is quite similar to that just described, excepting the shape and omission of the pocket. A bottom board 45″ long, 21″ wide and ¾″ thick is required. This will have to be glued up from two pieces, and then carefully leveled with a plane. Three cleats 20″ long 4″ wide and ¾″ thick, are screwed to the bottom to prevent warping. The side pieces are



46 ½″ long, 3″ wide and ¾″ thick. The end pieces are 22 ½″ long, 3″ wide and ¾″ thick, the joints being mitred. An alley 2″ wide is made at the right side by means of a strip of wood 21″ long, 2″ wide and ⅜″ thick, the upper end being

cut to an angle of 25°, and is fastened in place by means of long screws of small guage, put through from the inner side and end piece.

The curved piece at the top is made from a clear strip of wood taken from a cheese box, planed smooth and of even thickness. and is about 27″ long, and 2 ¼″ wide. The ends are let into the side pieces so as to make a smooth curve with a radius of 10 ½″. Holes 1″ diameter are bored ⅝″ deep, preferably with a Forstner bit, so as to leave no screw holes or spur marks. The location of the holes and also for the pins are plainly shown in the illustration. The pins are strong brass round head nails 2″ long, which may have to be obtained on special order by your hardware dealer. They should be evenly spaced, their location being first drawn out on paper and then marked on the board by pricking through. In the centre of the 200 circle a 4″ gong is mounted, and also in the 100 circles, 3″ gongs. This may be done by twisting a piece of tin into a tube of the proper length to bring the edge of the gong ½″ above the board and then putting a round-head screw through to hold it.

A block of wood 7″ x 2 ¼″ x 2″ is fitted to the lower end of the alley, a hole ½″ diameter bored through it lengthwise, and the inner end cut to a half circle as shown to receive the marbles. A plunger may be made from a piece of ½″ dowel, with any suitable handle such as a brass door pull fastened to the outer end, with which it is pulled out and also serving to hold it. A heavy rubber band is tacked to the side and end, and tied to pull knob, to give a strong recoil when the plunger is released by the fingers, after being pulled out, or the hole in the block may be made larger and a strong wire spring put over the plunger, one end being fastened to the inner end of the block, by putting it through a small hole bored for the purpose and plugged ; the other end being carried around the screw of the knob.

Before putting in the pins or the gong, the wood should be stained, and varnished. Small moulding around the edges will also add to the appearance. Short legs to bring the upper end from 6″ to 9″ higher than the lower end should be fastened with hinges to the cleat on the upper end. The incline is a matter of choice as to whether it shall be greater or less than above. The marbles should be about 1″ diameter.

THE DESIGN AND USE OF GAS ENGINES.

FRANK N. MARTIN.

I. Types of Engines.

The extensive increase within the last few years in the use of gas engines as generators of power for automobiles and launches, and to almost as great an extent for stationary purposes, has developed a general interest in their design and use, and it will be the purpose of this series of articles to so present the subject that the reader will, at their completion, have sufficient knowledge to be able to clearly understand the general features of the different types, and the proper workings of their path.

The designation of "Gas Engine" as here used includes all engines using gas or oil vapor for producing an explosion in the cylinder of the engine, but owing to the limitations of space, only the more commonly used types will be described. It is well to mention, however, that engines using kerosene or petroleum vapor, as well as acetylene gas, are receiving much attention at the hands of inventors, and successful results have already been achieved. In the near future, therefore, we may expect important developments in these other types of engines.

Gas engines require a mixture of inflamable gas or vapor and air, the mixture of the two being effected before introduction to the cylinder and subsequent combustion. Air is an important necessity for two reasons; that of providing the necessary amount of oxygen to render combustion possible, and to secure the expansive effect due to the heat generated by the combustion or explosion. In fact, the greater the amount of air

used in effecting the mixture, the more economical the engine, from the greater expansive effect of the larger volume of heated air.

The working process of a gas engine is as follows: — The mixture of explosive gas and air is introduced into the cylinder, then compressed explosion follows, generating a high heat and consequent pressure forcing the piston outward. The products of combustion, gases of a different character, are then expelled from the cylinder, which is then recharged with a fresh mixture and the process repeated.

The working cycle of an engine is seen, therefore, to consist of four parts; charging, compression explosion and expansion, and exhaust. When these are effected by four movements of the piston, two outward and two inward, or two complete terms of the crank, it is termed a "Four Cycle" engine. When only two movements of the piston, one in each direction are necessary, it is a "Two Cycle" engine. With the four cycle engine, during the first outward stroke of the piston, the mixture is drawn into the cylinder at atmospheric pressure by the suction of the piston, the inlet valves closing at the end of the stroke. The first inward stroke compresses the gas to a high pressure and occupping but a small portion of the space at the inner end of the cylinder. Combustion follows generally just previous to completing this inward stroke. The pressure caused by the heated gases and air then causes the second outward or impulse stroke, the return stroke clearing the cylinder of the gases produced by the combustion, and completing the cycle.

With the two cycle engine, the compression of the gas and air mixture is effected in an external chamber, usually the crank case, which is made strong enough to withstand considerable pressure, and small enough so that the piston on its outward stroke will cause the compression of the mixture therein contained. When the piston, on its outward travel, has reached a certain point, an inlet valve admits the compressed mixture in the crank case to the cylinder, the entry being rapid owing to its compression. The inward stroke of the piston then begins, the inlet valve closes, the mixture is compressed, then exploded at or about the end of the inward stroke when the compression is greatest, the high heat causes the outward or impulse stroke. At a certain point in the outward stroke an exhaust valve opens, the gases escape in part, so that the pressure is greatly reduced. This is quickly followed by the opening of the inlet valve, the incoming mixture of fresh gas assisting to force the exhaust gases through the exhaust opening, and the process is repeated as before. In this type of engine the several parts of a cycle more or less lap on to the one succeeding it, with the result that each part is not as fully completed as with the four cycle type, and the speed of the crank shaft cannot be as great, therefore, with the former as with the latter kind. The gain in power due to the increased number of impulses strokes is offset to quite an extent by the slower speed at which the two cycle engine must run.

The uses, therefore, for which the engine is intended, and its size and power enter considerably into the determination of the type to be selected. As a general proposition it may be stated, that for small engines of one cylinder up to 5 H. P. the two cycle type is most largely used, but for larger engines, and especially those of two, three or four cylinders, the four cycle is preferable. This has reference to marine and automobile engines. For stationary purposes, this statement must be modified by matters which will receive consideration in a future chapter.

CONTINUED IN THE JANUARY NUMBER.

The most expensive saws in the world are those in use in the factories of Pennsylvania, where various articles are manufactured from the slate. In one of these factories there are 300 horizontal saws, 12 ft. long, each of which is furnished with seventy-five cutting diamonds, each saw being worth $5000. Roofing slate is split and turned by special machinery; but when the slate is cut up for use in other ways the procedure differs. The huge horizontal saw, with its scores of diamonds, is lowered upon one of the blocks of slate by a ratchet at the rate of $\frac{1}{4}$ in. per minute. The saw would cut through iron or steel at the same rate. A stream of water plays upon the slate to keep it cool and wash the dust from the cut. After the sawing, the block is planed by being moved backwards and forwards by machinery under a firmly fixed chisel. It is afterwards polished, much as blocks of marble are.

A MODEL ELECTRIC RAILWAY.

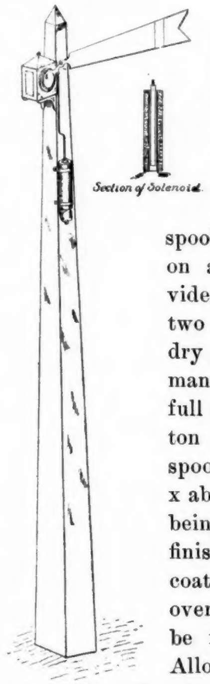
Robert Gibson Griswold.

IV. A Semaphore.

The electric semaphore is an electrically operated signal which denotes, in the case of a block system, a clear or otherwise block, or section of track. The fact is indicated by the position of the semaphore arm with regard to the pole. When it hangs down at an angle of about 30° the block beyond, and over which it has control, is supposed to be clear; if the arm stands at an angle of 90° as shown in the cut, the block is already occupied by another train or car as the case may be.

In order that the semaphore may properly perform its function it is necessary that an electrical connection be made such that the presence of a car upon that particular brook controlled by the signal will cause the solenoid to draw the arm into a horizontal position. In the present case this is accomplished by insulating the two rails from each other in every section of track where this signal is used. A wire is then connected between each rail and one of the solenoid terminals, one of these wires having a small battery connected in series with it so that the current when passing through the rails, across from one to the other through the car axle, and through the solenoid will cause the signal to act. This semaphore cannot well be worked from the general current on account of the difficulty in winding the coil so that a small current will make it sufficiently powerful, and the interposition of the proper resistance to keep the power current from operating the signal at other than the proper time.

The movable arm is mounted on the side of a pole about twelve or fifteen inches high as shown. It is lightly pivoted on a small wire nail, the motion being limited by two similar nails being driven in above and below the arm. The arm is best cut from aluminum and one end provided with a circular opening into which a piece of red glass is cemented with pitch. The weight of this glass should not be so great as to overbalance the longer end, but the latter should be sufficiently heavy to cause the arm to fall when the current is shut off, drawing the iron core out of the coil as it falls. The vane or longer portion should be painted red with a white strip across the outer end, or this stripe may be made by leaving the metal unpainted.



The solenoid is simply a coil of wire wrapped around a small tube of paper. This coil acts as a magnet when the current is passing around it, and will draw a piece of iron into the tube with considerable force. Make the spool either of wood turned out on a lathe, or a stiff paper provided with two flanges and given two coats of shellac. When quite dry place spool on a small wood mandrel and proceed to wind it full of No. 25 B. & S. single cotton covered magnet wire. The spool should be about 1 $\frac{1}{4}$″ long x about $\frac{3}{8}$″ in diameter, the hole being $\frac{3}{16}$″ in diameter. Give the finished winding two or three coats of shellac and place in an oven to dry, after which it will be found very hard and firm. Allow the ends of the wire to extend from thecoil at least 15″.

The core for this solenoid is made of a tenpenny wire nail which is about $\frac{1}{8}$″ in diameter, and slightly shorter than the coil. One end is fastened to a wire which runs up as shown and hooks fast to the arm about $\frac{1}{4}$″ from the pivot. The iron core should move easily in the spool, and a small nail or pin driven into the pole just above the spool will serve to prevent its touching the tube while moving. The solenoid may also be located at the base of pole, enclosing it in a box frame with sloping roof to represent a signal box

A small tin lamp box is made and attached to the pole, inside of which is secured a small pea electric lamp, the wire from which pass down the side of the pole or through a hole drilled through the centre of the pole, the wires entering a hole drilled at right angles as shown for the solenoid wires. This makes a very neat job. The lamp box is provided on the side with a circular opening which is just the size of the glass in the semaphore arm. When the arm falls the red glass uncovers this opening and the white light shows instead. The light should be connected to separate battery, as in fact they all should, so that shutting down of the power current will not affect them.

This signal may also be used to indicate the condition of a switch on the main line; one position, generally the horizontal, indicating that a switch is open; the fallen position indicating that the track is clear and the switch closed.

Olona, which has been made an object of experiment by the station of the Agriculture Department at Hawaii, seems likely to become an important textile. It belongs to the nettle family, resembling ramie, but having no resin, it is easier manufactured than the plant. Ordinary sized ropes made of olona fibre are silken in their fineness and as strong as a ship's hawser. Ropes, nets and fish-lines are found to be impervious to the action of salt water. In Hilo, an aged native fisherman was found using an olona trawl which he had inherited from his grandfather. The line still seemed to be as strong as a steel rope. Olona is also remarkably light. Strands that weigh no more than twine have the strength of wire. Garments woven of this fibre, though delicate in texture, are said to be almost indestructible, and with ordinary use will outlast the lifetime of the wearer. It thrives best in Tropical forests 2,000 ft. above sea level.

Professor Max Wolf, the director of the Observatory at Heidelberg, has discovered, by means of photography, two new planets, having a radiance approximately equal to that of stars of the twelfth magnitude.

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MACHINE DRAWING.

II.

The shapes of rivets and rivet heads were given in the previous plate. Three examples of riveted joints are here given. That shown in Fig. 7 is a single riveted lap joint. The general usuage governing the spacing of the rivets for such a joint is: — The distance from the edge of the plate to the rivet hole, or to the next rivet hole, shall not be less than the diameter of the rivet, the shearing stress on the rivet and the tearing limit of the plate being assumed to be about equal. The thickness of the plates and the diameter of the rivets are determined by the pressure to which the joint is to be subjected. The objection to a lap is that the straining force of one plate is not in line with the joint, but tends to bend it with consequent weakening effect.

A single riveted butt joint is shown in Fig. 8, the edges of the plate being brought together, and a strap of suitable width covering it. Two straps, one on either side of the joint, are also used, thus over-coming the bending action previously mentioned, and to which a butt joint is subject to nearly the same amount as the lap joint, with a single strap butt joint it is customary to use a strap which is one-tenth to one-eighth thicker than the plates. When two straps are used the thickness of each is about five-eighths that of the plate.

The double riveted butt joint is shown in Fig. 9, the spacing between rivets being clearly shown. A simple riveted joint has about 60 per cent the strength of the plate, and a double riveted joint about 75 per cent. As constructional requirments frequent necessitate joints so shaped as not to permit of riveting in the ways just shown, the shapes shown in Figs. 10 to 13 are used. Fig. 10 is that known as angle iron, its thickness being generally a little greater than that of the plates used with it. A slight taper is also given it so that the root will be thicker than the edges. Fig. 11 shows a T iron, used for holding plates and also stiffening them against flexure. Fig. 12 gives a shape of channel iron, much used in locomotive construction. Fig 13 is H iron, which is another commonly used shape.

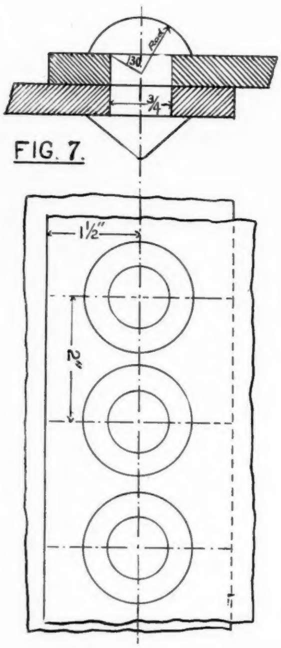


FIG. 7.

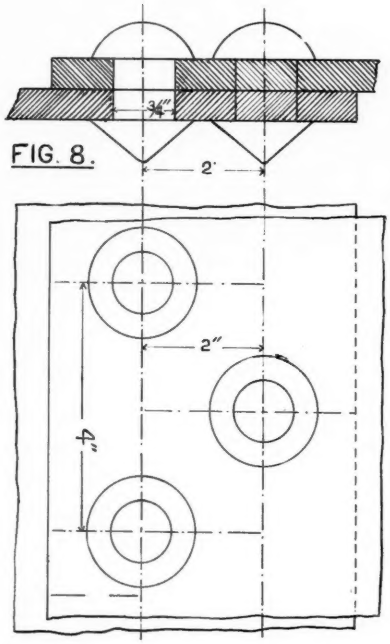


FIG. 8.

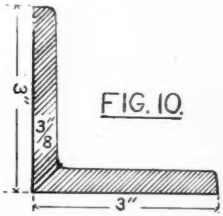


FIG. 10.

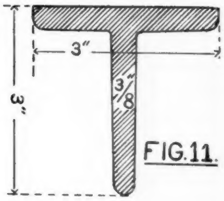


FIG. 11.

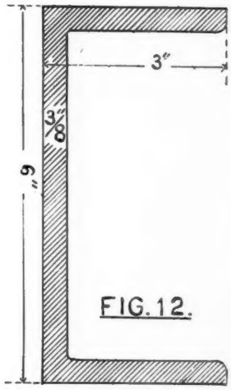


FIG. 12.

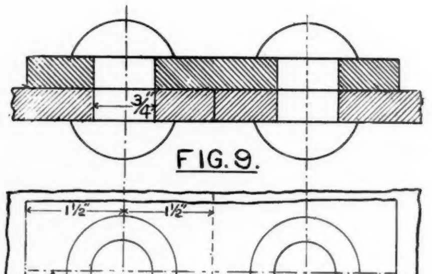


FIG. 9.

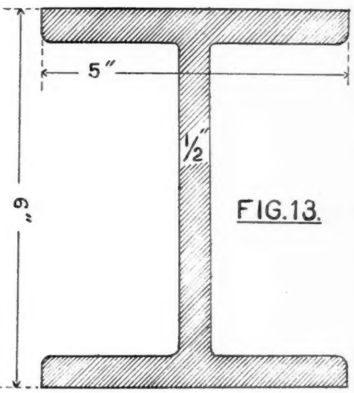


FIG. 13.

AMATEUR WORK

77 KILBY ST., BOSTON

DRAPER PUBLISHING CO., PUBLISHERS.

A Monthly Magazine of the Useful Arts and Sciences. Pubshed on the first of each month for the benefit and instructio, of the amateur worker.

Subscription Rates for the United States, Canada and Mexico $1.00 per year. Single copies of any number in current volume, 10 cents.

TO ADVERTISERS.

New advertisements, or changes, intended for a particular issue, should reach the office on or before the 15th of the previous month.

Entered at the Post-office, Boston, as second-class mail matter Jan. 14, 1902.

DECEMBER, 1903.

This is the last month of the special prize offers. Some of our readers will secure valuable tools, and the magazine a largely increased list of interested readers.

The near approach of Christmas leads to the suggestion that new subscribers are easily secured this month if a little thought is given to selecting those who would be likely to be interested in the magazine. But few subscriptions are necessary to secure some of the many excellent premiums offered.

The large holiday business at the bindery has delayed the delivery of the bound volumes much beyond the time when they were promised, but volume II is now ready, and the reprint of volume I is nearly complete, and will soon be ready for delivery. These are excellent for Christmas presents.

The special premium offer of a Weno 3 ½ x 3 ½ camera for five new subscribers is an opportunity of which early advantage should be taken, the supply being quite limited, and the offer cannot again be made. See our advertisement for particulars, and learn that this is a chance to secure a fine camera with but little trouble.

Rock-salt mining is carried on extensively in five districts of New York State. The shafts are sunk in the usual manner, and the sides are prevented from caving in by heavy timbers, while to prevent water from entering the shaft a heavy layer of cement is put between the walls of the shaft and the timber. The shafts vary in size somewhat, the usual dimensions being 12′ x 18′, and 24′ square in the clear. The main galleries are about 30′ wide, their height depending on the thickness of the salt beds. Some salt must always be left as a roof and floor; hence, in a vein of salt 24′ thick, an allowance of 6′ for the roof and 4′ for the floor would give a gallery or chamber 14′ high. From the main chambers cross sections or galleries are run every 30′; thus the roof above is supported by pillars 30′ square. The salt is blasted out with dynamite. The drills are run by compressed air about 6′ into the solid salt, and they are set in such a manner that when the blast takes place, as much as possible of the salt remains in lumps. The salt is loaded into small cars, which are run on tracks laid on the floors of the chambers on to cages in the shaft, through which they are carried or hoisted to the top of the breakers, similar to those used in coal mining, and from 100′ to 145′ above the surface of the ground. To separate the lump salt from the finer material, the contents of the cars are dumped on a set of iron bars, which permit all the salt, except the lumps, to fall through into the crusher below; the lumps are loaded on to other cars and run down an incline to the ground, where they are stored, usually in the open air, for shipment. The finer material passes through the crushers on to sieves, and from the latter into the bins. Of the crushed and sifted salt, there are four kinds, according to size. The lump salt is mainly used for stock, the other grades for the same purposes for which sea or solar salt is required.

Sycamore, a most durable wood, is the substance of a statue known to be nearly six thousand years old, and now in the museum of Gizeh, at Cairo. The wood is stated to be quite sound and natural in appearance.

A JOLLY BALANCE.

ROBERT GIBSON GRISWOLD.

The jolly balance is especially convenient in the determination of the specific gravity of solid substances, insoluble in water, on account of the rapidity with which the work can be done. Owing to the fact that it is not necessary to obtain the actual weight in air, and that the readings are merely comparative, skill in rapid handling and accuracy in readings is soon acquired.

The specific gravity of such bodies as pieces of metal, alloys, ores and most minerals in general can be determined in a few minutes. The base *a*, is of triangular form and provided with three leveling screws, as shown, to level the instrument and bring the pans *c* with their suspension into a vertical line parallel to the pillar *d*. The triangular base *a*, is best made of 1 ¼″ oak, as this adds sufficient weight to make the instrument steady while in use. It is sometimes advisable to attach to the under side of the rear base arm a piece of sheet lead, say ¼″ thick so that overturning will not be likely. Over the centre of the base glue the circular block *c*, and through both the base and block a ⅞″ square hole is cut, into which the pillar *d* is driven and glued.

The pillar *d* is best made of maple, 1″ square. The lower end is tenoned to fit into the ⅞″ square hole in the base. The shelf *f*, is circular and 4″ in diameter, being glued to the bracket *g*, the latter in turn being secured by two thin screws to the pillar as shown. Upon this shelf is placed the beaker of water during the determination.

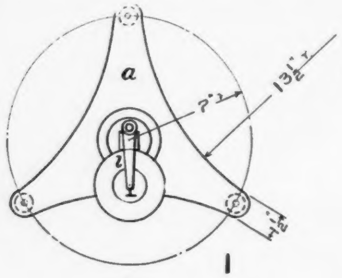
To the top of the pillar is fastened a brass guide *h*, being provided with a ½″ hole through which a ½″ brass tube passes. Just below on the same pillar is fastened another guide *i*, having the same size hole. These two guides carry the rod or tube *j*. The tube *j*, is the only moving part of the balance and carries the spring *k* suspended from an arm *l*, together with the pans *c-c*. It is made of ½″ outside diameter brass tubing which is quite true to size and very straight. The upper end is fitted with a plug which is sweated in, the end being filed off perfectly square. This plug is then drilled and tapped for a 10-32 brass round head screw. The arm *l* is filed out of $\frac{1}{16}$″ hard sheet brass and provided at the outer end with a boss and screw by means of which the spring *k*, is readily attached or detached.

To the lower end of the tube *j*, is attached a piece of thin sheet brass which just bears against the back of the pillar and keeps *j*, from turning. The pressure should be only sufficient to accomplish this object, and no move else the tube will work stiffly and accurate adjustment be rendered impossible. The construction of the lower end of this rod is shown in Fig. 3, also the lower guide and the stud to which the operating wire is attached. The spriug is simply soldered to the end of the tube.

The tube *j*, is raised and lowered by means of a fine steel wire passing over a sheave on the top of the pillar and wound around a drum at the base, this drum being provided with a hand-wheel to enable it to be turned in either direction. The shaft passes through a hole in the pillar and from the hole is cut a saw slot running longitudinally for ¾″ on each side. A screw passes from the back into the front of the pillar by means of which the wood may be compressed upon the shaft and thus holdlng the drum from turning. The wire should be about No. 30 or 32 steel.

Make the pans *c-c*, from sheet aluminum. They may be cupped if desired by beating to shape with a ball-pene hammer on a block of hard wood afterwards trimming to exact shape. They are supported by three fine copper or brass wires as shown. Pass the wire through the hole in the upper pan, then wrap once around itself as shown and then pass down to the lower pan. The intersection of the three wires from the upper pan is joined by a drop of solder to a straight piece of brass wire, about No. 25. One inch and a half above the joining of the three wires and this straight brass wire solder a small brass washer ⅜″ in diameter, and placed at right angles to the wire, to prevent undue oscillations.

To the pillar attach a block o, provided with two brass forks as shown in Fig. 4, which limit the travel of the pans. The spring k, is made of fine steel wire, No. 30 B. & S. wound on a slightly tapering wood mandrel, 12″ long, ¾″ in diameter at one end and ½″ diameter at the other. The coil should be about 5″ long when closed. Solder the upper end, which is the end with the smaller diameter, to a short piece of copper wire to afford a means of attachment to the arm The lower end should be made into a small hook to which the pans are attached. The reason for making the spring tapering is to avoid the undue stretching of the upper coils due to the weight of the coil itself. With this method of construction the coils gradually increase in strength from the bottom upwards.



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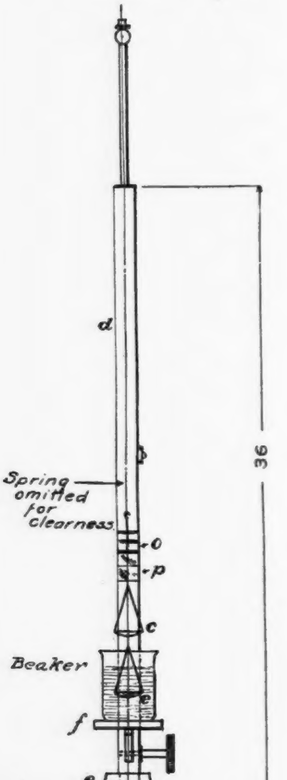

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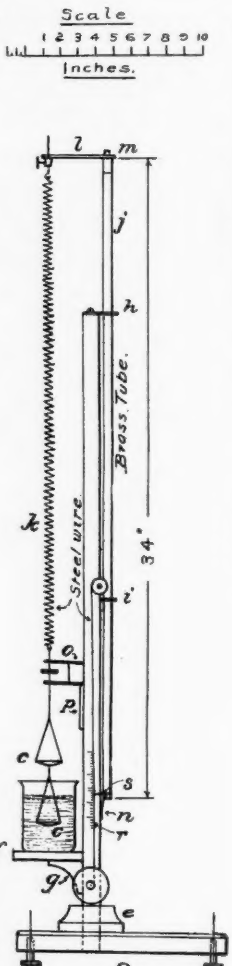

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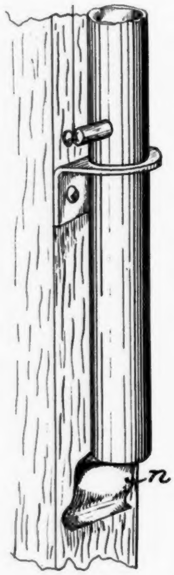


Fig 3.

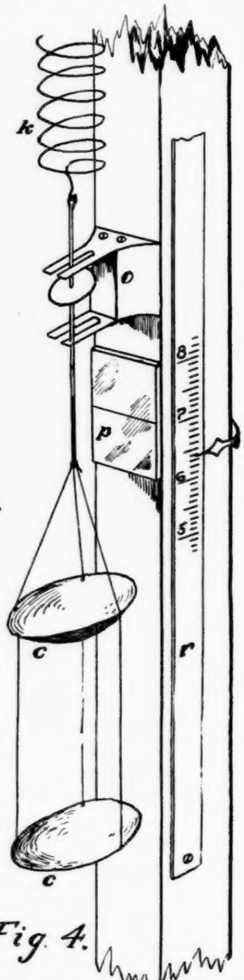


Fig. 4.

Just below the block o, secure to the pillar a piece of mirror p, as shown in Fig. 4. Across the face of the mirror scratch a fine line with a sharp end of a file, at right angles to the vertical axis of the instrument. Blacken the supporting wire

of the pans as indicated with india ink or lamp-black and oil, having the upper end of this blackened portion level with the line on the mirror when the washer is midway between the forks. Make a millimeter scale *r* of Bristol board about half a meter in length and attach to the side of the pillar as shown, numbering from the bottom upwards by tens. To the lower end of the rod *j*, fasten a brass pointer *s*, the sharpened end of which will just clear the surface of the scale. Make the scale divisions distinct and the ends of the pointer very sharp.

To illustrate the use of the balance, a determination of the specific gravity of brass will be used. The beater is nearly filled with freshly boiled distilled water. The rod *j*, is then adjusted by means of the hand-wheel until the edge of the blackened portion of the wire coincides exactly with its image in the mirror when looked at from the front. The reading on the scale is then taken and set down.

Now place the piece of brass in the upper pan and again adjust the rod *j*, until the image and blackened portion coincide and set down the reading, subtracting the first reading from it, the result corresponding to its weight in air. Then place the piece in the lower pan, being sure that it is completely covered with water, and adjust as before. This reading minus the first corresponds to its weight in water. Then calculate the specific gravity as follows :

Reading with body in air	127.3 mm.
Reading with pans empty	7.4 mm.
Spring extension due to weight in air	119.9 mm.
Reading with body in water	113.1 mm.
Reading with pans empty	7.4 mm.
Spring extension due to weight in water	105.7 mm.

$$\frac{\text{Weight in air}}{\text{Wt. in air - Wt. in water}} = \frac{119.9}{119.9 - 105.7} = \frac{119.9}{14.2} =$$

8.4 = specific gravity of the brass.

From the above will be seen that this method agrees precisely with the method in which a balance and weights are used. The above form of calculation is given in order that a clear understanding of the principle involved may be had by those unfamiliar with this class of work. It will often be noticed that text books give the following formula which is identically the same thing.

$$\frac{B - A}{B - C} = \text{Specific gravity}$$

A = Instrument reading, nothing in either pan
B = Reading with substance in upper pan
C = Reading with substance in lower pan

Inserting the assumed values given above we have

A = 7.4 mm.
B = 127.3 mm.
C = 113.1 mm.

$$\frac{127.3 - 7.4}{127.3 - 113.1} = \frac{119.9}{14.2} = 8.4 = \text{specific gravity}$$

A HAND CYLINDER PRINTING PRESS,

Suitable for an Amateur's Newspaper, Posters and Proofs.

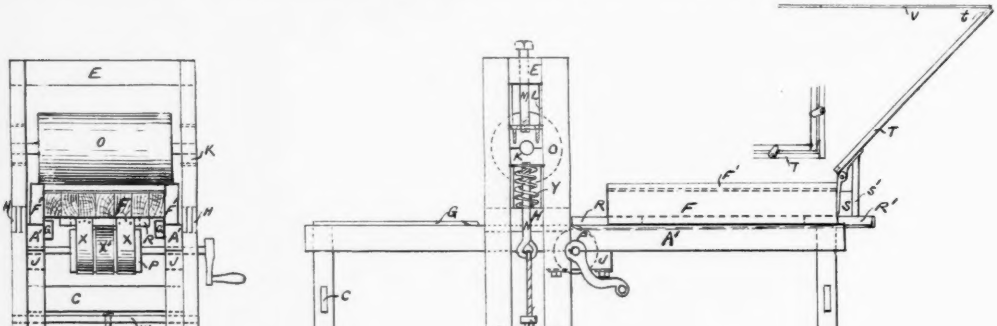
Many amateur printers find the cost of a press large enough to print a small newspaper, much too great to permit of their obtaining them, and so are obliged to do without the instructive pleasure and profit incident to amateur journalism. As the work of printing the paper is quite as enjoyable as that of editing it, the press here described will afford those of fair mechanical skill a way to have a press upon which good work may be done at fair speed. It is much like the old Adams hand press, many of which are still to be found in small towns where a small weekly paper serves up the local news to a very limited number of subscribers. The size here described will print a form 14″ x 20″ or the size of two pages of this magazine. A very neat amateur paper of four pages could be printed by running two pages, and then turning and running the other two pages.

The frame is made of 2″ x 3″ spruce joist, which planed all over will measure 1 3-4″ x 2 3-4″. The four pieces *A*, are 61″ long, mortises 7-8″ wide, being cut 1″ from each end for receiving the tenons on pieces *B*. All mortises and tenons should be very carefully cut on each end. In addition, cut mortises 1″ wide, 5″ and 18″ from the lower ends for cross pieces *C*. Four pieces *C* are 16″ long, tenons being cut on each end to fit mortises in *B*.

The four pieces *D*, are 47″ long, and bolted 3 3-4″ apart to the pieces *A*, after attaching the cross piece *E*, and fitting the pieces *H*, which are mortised, the lower edge being 25″ from the floor. The two pieces *H*, are 10″ long, with tenons on each end. The piece *E*, is 22″ long, 3 3-4″ wide, and 2 3-4″ thick, and fast-

ened to the top ends of D with 1-4″ lag screws with washers under the heads. Bore holes for these screws before driving and place them so they will not interfere with the bolt M. The centre line between pieces D, is 25 1-2″ from the left ends of the frame pieces A, as shown in the illustration.

The two pieces J, are 8″ long, and fastened with 3-8″ lag screws to the under side of the pieces A', the fit of the joint being square and close. A 1 1-4″ hole is bored 31″ from the left end, the centre of the hole being in the joint between the two pieces J and A, and the hole being bored exactly square and true. Pieces of brass tubing 2″ long, 1″ internal diameter and 1-8″ thick are then fitted to these holes, forming countersunk for the heads of the screws. The top surface of the brass plate should be absolutely level, smooth, and firm, so that the type form will be evenly and firmly supported. Along each side are screwed maple strips F', 24″ x 5 1-2″ x 1 1-2″, the lower edges being dropped 1 1-2″ below the under side of F, and about 1 1-16″ above the top of F, forming bearers for the ends of the cylinder O to rest upon. The upper edge should be absolutely even and exactly the same height at all points. The ends are slightly beveled, so the cylinder will be taken up easily. These pieces form the runners for carrying the bed F to and fro. Before finally fastening in position, carefully measure the distance between the inner



a bearing for the shaft of the cylinder P. This cylinder is of wood 5″ in diameter, and 8″ long, and preferably should be glued up of four pieces and then turned down. The shaft for same is 1 1-4″ square drawn steel, 22″ long, turned down in a lathe to 1″ for the bearings, the length turned on one end being 3″ and one on the other 6″. Or a solid cylinder of wood can be bored at each end with a 1″ bit and pieces of 1″ shafting fitted therein, but great care must be used to locate the holes exactly in the centre of the ends. The outer front end of the shaft is filed square to fit a handle; one used for grindstones will answer, and these may be purchased at most hardware stores.

The bed F is glued up from strips of selected maple, which has been well seasoned. The dimentions are 14″ x 24″ x 2 1-2″. Unless the builder has suitable clamps this can best be gotten out at some wood-working shop, as it must be well done and the top absolutely level. When complete a sheet of brass 1-8″ thick, 24″ long, and 14″ wide is fastened with 1 1-2″ brass screws to this wooden support. Holes spaced 3″ apart are drilled all around the edge and edges of the upper pieces A, and space the pieces F' a trifle further apart so they will not bind on the guides G. The lower inside edges of F' may be planed with a rabbet plane to secure the proper fit. On each corner of the bed F, are attached corner pieces made of brass bent to an angle and well fitted, and securely attached with several screws. These keep the chase in position when doing work. They project above the top of the bed a trifle less than the thickness of the chase and should not be fitted until the chase is secured so that the latter may be used in making the fit.

The movement of the bed is secured by means of belts fastened at one end of the cylinder P, and at the other ends to the frames R, fastened to the under sides of the ends of the bed. Three pieces 8″ long and 1 1-2″ square are needed for each frame; two projecting pieces and a cross piece. The joints are halved and firmly fastened with screws and the inner ends screwed to the under side of the bed. Three pieces of 1 1-2″ belting 38″ long, are required; the centre one being fastened to the frame at right or outer end of the bed, and the two outer strips to the

frame as the left or inner end of bed. The ends of the belting on the clyinder are fastened first, the bed moved the full distance to one end and the outer end of belt on that end fastened; then moved to the outer end and the end of the other belts fastened.

By turning the handle to cylinder *P*, the bed can be moved as desired. The guides *G*, are 61″ long, 1″ thick, and 2″ high, and are firmly attached to the inner edges of the pieces *A′* so that they are 1-2″ higher than *A′*. Graphite or axle greese is used to lubricate the ways. To the outer end of the bed two blocks *S*, 4″ x 3″ x 2″ are attached, one on either side, to which are attached pieces *S′* 7″ x 2″ x 1″, the upper ends being beveled. The tympan *T* rests upon these pieces when laid back for the insertion or removal of the paper.

The tympan is a double frame made of oak strips 3-4″ x 1-2″. These frames are made exactly alike, one fitting inside the other with about 1-16″ space between. The end at *t*, is not made of wood, but of a strip of steel, 14″ long, 1-2″ wide and 1-8″ thick. The outer frame is 25″ long; and 15″ wide, the inner one 23 3-4″ long, and 13 3-4″ wide.

The impression cylinder *O* is 8″ diameter and 12″ long. It should be built up from four pieces of clear grained, well seasoned maple, and mounted on a shaft made of 1 1-2″ square steel. In addition to gluing, it is advisable to bore holes at each end through each two adjoining pieces and put through dowels which should also be well glued. When the glue is thoroughly dry, mount in a lathe and turn off the shaft for bearings to 1 1-4″ diameter, and then turn down the cylinder, using care to have it of uniform diameter. As this part of the press may be beyond the capacity of some readers, it can be ordered at some pattern makers or wood working shop.

Another way to make it, and also the cylinder *P*, is to buy steel or brass tubing, close up the ends with wood or brass plate, carefully locate the centres and drill holes for a piece of 1 1-4″ round shafting. It can then be mounted in a lathe and a light truing cut taken off, and then polished. If tubing is easily obtainable, this will cost less, and also be easier than to use wood. The shaft is 21 1-2″ long, and 1 1-4″ diameter. The journals *K*, are each made of two pieces of maple 3 1-2″ x 2″ x 2″. The two pieces are put together in a vise and a 1-2″ hole bored for the shaft, the centre being on the joint. Pieces of brass tubing are used for bushing, to prevent the shaft from wearing down the wood. Slots 1-2″ wide and deep are cut on the ends vertically fitting the ways *L* made of 1-2″ square maple strips 14″ long. The bolt *M* and eye-bolt *N* are each 8″ long, and 3-4″ or 7-8″ diameter. These may have to be made up to order by a blacksmith, in which case use steel shafting; so as to secure a smooth finished surface. The ends are threaded to fit plates screwed to the journals *K*. The hole in the piece *E* for the bolt *M* should be an easy fit, but not loose, as should also be the hole in the piece *H* for the eye-bolt *N*. By turning the bolts *M* the impression of the cylinder is regulated. The plates at the top and bottom of the journal have projecting lugs, two inside and one outside, to receive the ends of 3-8″ bolts 5″ long, which hold the journal together but are not shown in the illustration.

Steel expansion springs 5″ long, and strong enough to hold the cylinder up, are put between the journal and the piece *H*. Pieces of strong rope or twisted iron close-line, are attached to the eyes in the bolts *N* and to the ends of a piece of oak *W*, 21″ long, 2″ wide and 1″ thick which is about 16″ from the floor. From the centre of *W*, drop another piece of rope or wire to the treadle *W′* which is 22″ long, 3 1-4″ wide and 7-8″ thick. The inner end of the treadle is hinged, with a strong T hinge to the piece *A*. The travel of the outer end need not be over 3″. If the weight is too great for the springs under the journals *K*, a spring may be attached to the front end of *W′*. By pressing with the foot upon the end of *W′* the cylinder *O* is brought down on to the bed *T*, the latter then laying upon type with the paper between.

To prepare the press for work, the two frames of the tympan are each covered with a smooth covering of muslin or sheeting, the form placed upon the press, guage pins located, and an impression taken on a sheet of the paper to be used for the run. If this press proof be examined, the impression may not be found uniform, in which case adjust the bolts *M*, and then correct local heavy or light places by pasting up and cutting out layers of paper which place between the cloth covering the two frames of the tympan. This is called the "make ready." A long two-handled ink roller and a piece of thick glass or marble are needed for inking, and a table for the blank and printed sheets. To take an impression lay a blank sheet upon the tympany ink the type, bring down the flies *V*, place the tympan upon the type, turn the crank carrying the bed under the cylinder, press the lever firmly but not too hard with the foot, turn the crank in the reverse direction bringing out the bed under pressure from the cylinder, lift the tympan, throw up the fly and remove the printed sheet. After a little practice, excellent work can be done on a press such as is here described. Any points not clearly understood by readers will be further explained in the correspondence column.

Hardness in lead pencils is obtained by compressing the graphite mixture into the form ready to be glued into the wood casings. A highly compressed mixture produces a pencil of greater wearing qualities, an important feature in a high grade pencil. Hydraulic presses are used for the purpose, and the mixture of clay and graphite, which is still in a plastic condition and has been formed into loaves, is placed into these presses, which are provided with a die depending on the sectional area of the lead desired; through this die the material is forced.

A POWER DORY.

Carl H. Clark.

V. The Engine and Fittings.

The engine is now to be obtained and installed. The question of the best make will be largely a matter of personal preference and also of price. Almost all of the engines on the market are capable of satisfactory running if properly adjusted and taken care of. A large part of the trouble experienced by amateurs in running gasoline engines is caused by lack of proper adjustment. Good care should be taken not to change the adjustment of the engine as obtained from the makers until after it has had a thorough trial in the boat and the owner is familiar with its action under all circumstances.

When ordering the engine, the distance from the after side of the deadwood to the flat part of the bed should be given to the engine dealer, to be sure of getting the shaft long enough. In the matter of spark coil and batteries, it is to be urged that only the best be purchased, as use on salt water is very severe, and cheap materials very soon go to pieces, and cheap batteries very soon run out. It is advised that a magneto be used for ignition, using the batteries for starting only.

The first step will of course be to bolt the engine in place. It should be placed upon the bed, with the shaft in place in the hole in the deadwood. This hole is of course larger than the shaft, and the engine is now to be adjusted, either by cutting the bed slightly, or in any other way, until the shaft is directly in the centre of the hole. It may perhaps be necessary to trim the inside end of the hole with a gouge to get the proper clearance. At the same time the brace between the engine beds may be fitted to the round of the under side of the base, and then fastened in place by lag screws.

To get clearance for the fly-wheel, the beds will need to be notched out, this should be done until the fly-wheel has about 1-4″ clearance. A clearance must also be allowed for the crank in starting. When everything has been brought to a good bearing, holes may be bored for the lag screws which hold down the engine. These screws will probably be 4 or 5 inches long, and the hole is bored to fit the size at the bottom of the thread. It will be rather a nice piece of work to fasten the engine into place without cramping the shaft and causing it to bind in the hole.

The stern bearing may now be slipped on over the shaft, and brought up against the deadwood, to which it is to be carefully fitted and bolted, with a layer of lead between. This piece, also, must be carefully fitted, or it will otherwise bind the shaft and cause friction and wear. When all is secure, the engine should turn over freely by hand; this point is very important and must be carefully observed.

In describing the installation of the engine it will be hardly possible to give an exact description of all the work, as no two engines are piped up in exactly the same manner. When ordering the engine, detailed directions for fitting up should be asked for. In many localities the engine maker can refer the buyer to one or more of his engines already in use. Seeing an engine already in place will be of great help to the amateur builder, and together with the somewhat general directions here contained will enable him to fit up his engine with little trouble.

It will be best to have the several lengths of pipe cut and threaded by a pipe fitter from the measurements, as this work requires special pipe tools too expensive for the amateur to buy. The heavy piping for the exhaust should be fitted first, together with the muffler. Some makers furnish two small mufflers instead of one large one. The mufflers are placed under the deck aft, and the exhaust is carried out through the stern-board. The exhaust pipe runs directly from the engine to the muffler, which is so placed that there will be space between it and the sternboard to easily accommodate an elbow horizontally, from the muffler the pipe extends horizontally a few inches, then with another elbow it extends up the sternboard and out through it, with another elbow and short pipe just above the rudder stock. In case two smaller mufflers are used, or for any reason, the arrangement outlined cannot be used, it should be kept in mind that the arrangement shouldbe as simple and direct as possible.

It will be noticed that there is a union between the muffler and the engine; this is necessary to allow it to be fitted into place. In fitting up this piping, the part beyond the union is made up first to fit into place; the short pipe which extends through the stern-board is a threaded close nipple, and is to have a locknut screwed on outside when it is in place; the straight pipe in the forward end of the muffler is fitted with one part of the union. This portion is then held in place while measurements are taken for the pipe between the engine and the union; the latter piece is screwed into the exhaust hole in the engine and the connection made with the union. The necessity for the union will now be seen. A locknut is screwed over the short nipple on the outside of the sternboard to secure water tightness and hold the pipe in place. A cleat is fastened under the after end of the muffler

to take the weight and hold it in place. Whenever the pipe comes in contact with any of the woodwork a piece of asbestos should be tacked between to prevent the woodwork being charred by the heat.

most convenient. When the engine is received it will propably have a stem in the suction pipe ready to connect. The connection with the bottom or side must, of course, be water tight and is connected to the part already in place with a piece of flexible tube, so that the vibration of the engine will not disturb the connection with the plank. If it passes out through a

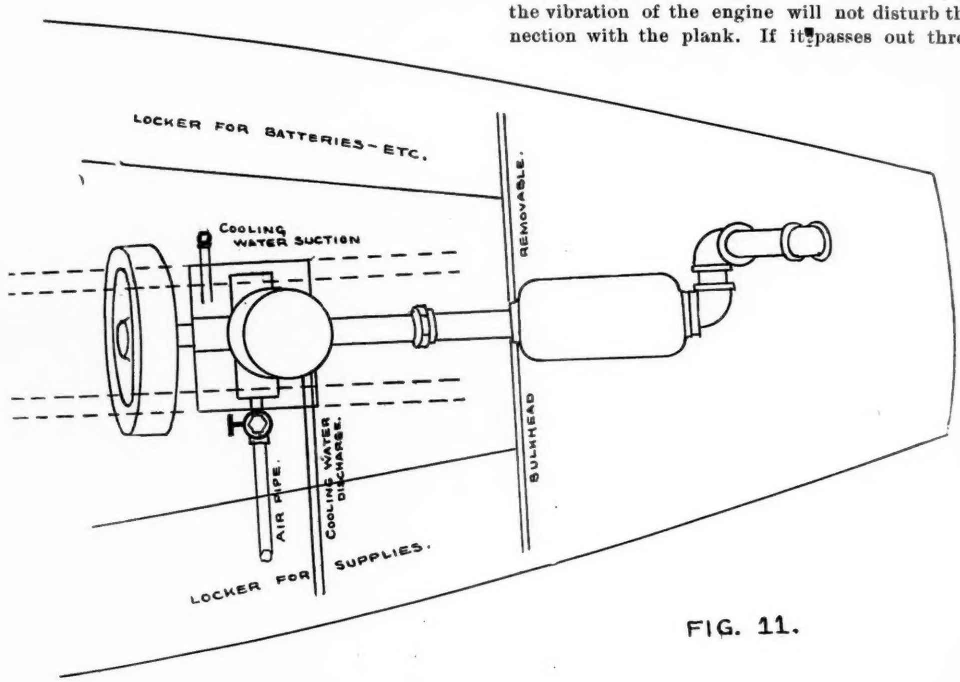
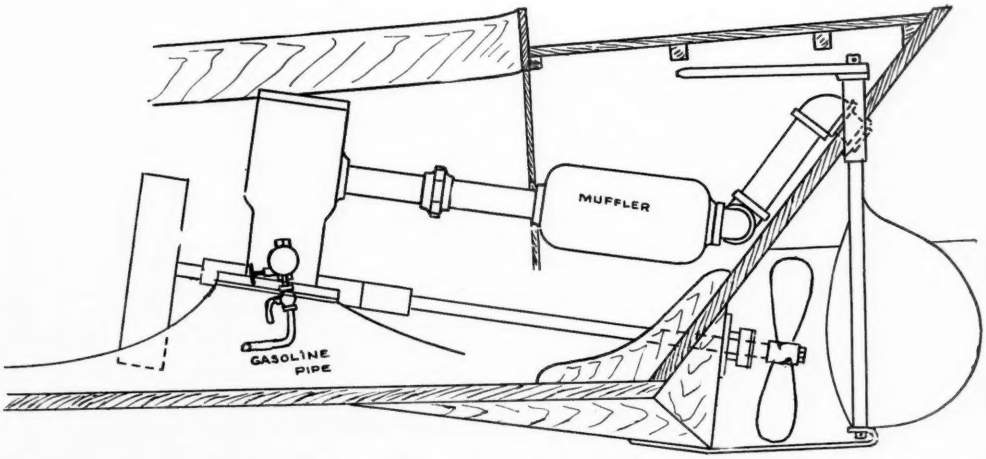


FIG. 11.



The cooling water should be piped up next. As wilf be seen, this water is circulated by a small pump, which draws water from the outside, and discharges it around the cylinder and overboard. The suction pipe leads either through the side or bottom, as is

plank, a piece of oak should be fastened on the inside to reenforce the plank.

A piece of fine wire gauge is to be fastened over the end of the pipe to prevent dirt from filling it. It is also advisable, but not absolutely necessary, to have a

valve on this water inlet next to the plank; this valve, when closed, prevents all chance of the boat being flooded by accident when not in use. The outlet from the engine leads outboard above the water line. The vaporizer is located near the base of the engine, and is connected to the tank by a small lead or brass pipe. Lead is preferable, as is easily bent to fit into place. There should be a stop-cock at the tank and at the vaporizer, and the pipe is connected to these by a wiped joint and union. There must be as few joints as possible in the gasoline pipe, as leakage at this point is very dangerous. The pipe should be placed under the seat on one side, running through holes bored in the moulds at about the height of the vaporizer, to avoid all low places, which pocket gasoline.

The vaporizer has also an air inlet which admits air, this may sometimes take air from around the muffler, but ordinarily has merely an open pipe. This pipe is to be led into a sheltered place to protect it from spray, and it must also be so placed that waste or cloths will not be drawn into it by the suction. It might well be led into one of the side lockers and a portion of it partitioned off.

All joints in water pipes should be screwed together with a coating of red lead between; joints in the exhaust pipe should be tight, but need nothing in them, in the gasoline pipe all joints should be wiped with solder, except those made by the unions themselves where a leather washer is used.

In fitting up the electric ignition, it should be borne in mind that a large proportion of the trouble with gasoline engines is caused by some defect in the electric system. The electric supplies are usually included in the outfit, but if they are not, the ones purchased should be the best in the market, as use about the water is very severe, and cheap articles soon go to pieces. If it is intended to run continously on batteries, a double set, of 6 or 8 each should be used. They should be placed in a double row in a box which has previously been thickly coated inside with asphaltum paint, to prevent the collection of moisture. As shown in Fig. 12 the zinc of one battery is connected to the carbon of the next, the two wires connected to the two end zincs coming out through holes in one end and those on the two carbons at the other end. The cover should be fastened on. The whole is now placed in one of the side lockers, where it will be dry. The spark coil is thickly covered with wax, or other waterproof material, as water very soon spoils it. This coil is placed in the locker along side of the battery box.

A double point switch is placed on the outside of the locker in a convenient position. There are two connections on the engine, one to the body of the engine, termed the ground connection, and one to the firing pin. The connections are as follows: — The two wires at one end of the battery box are brought together, and joined to a single wire, which is in turn carried to one of the connections on the engine. The two wires at the other end are connected, one to each outside point of the three point switch, and a single wire leads from the middle point to one terminal of the coil. A wire from the other terminal of the coil to the remaining connection on the engine completes the circuit.

It will be seen that when the switch is in connection with either point there is a continuous circuit formed through either set of batteries as desired, or it may be thrown off entirely when the engine is at rest. The joints in the wires should be carefully made, and might well be soldered. The circuit can be tested by closing the switch, loosening the wire from the firing pin and scratching it upon some of the bright parts, of the engine, a brilliant spark showing if all connections are complete.

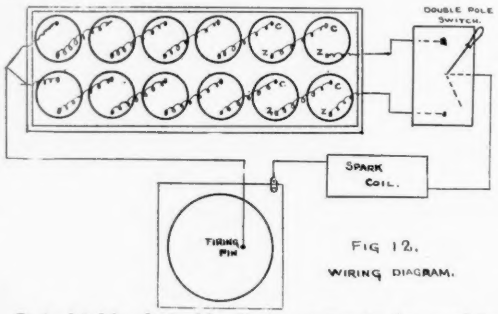


FIG 12.
WIRING DIAGRAM.

It is highly desirable that a magneto be used for continuous running, as batteries are inclined to become weak when used continuously. The magneto may be driven either by a friction pulley resting against the fly wheel, or by a belt on the flywheel, in which case it may, if desired, be placed in one of the side lockers, and the belt run through holes in the stairing. The wires from the magneto are connected so as to simply replace one of the sets of batteries already described, a single set only being used. By changing the double point switch the batteries may be used in starting and the magneto switched in after the engine is in motion.

When the engine is all piped up the remaining bulkhead at the after end of the standing room can be fitted; it should be so arranged as to be easily removable, to get at the piping and tiller ropes. The floor may now be laid and fastened in place. It may be well to leave one board loose down the middle as there is a space 3″ deep which may be used for small storage.

Before putting the boat into the water, the stern gland should be packed with suitable packing to prevent leakage around the shaft. Directions for starting the motor will usually come with each engine. If the amateur is not used to running this type of engine he should obtain assistance from someone familiar with gasoline engines and their operation. It is also advised that anyone unfamiliar with these engines get and study a copy of any of the recent works on gasoline engines and become familiar with the principles upon which they work.

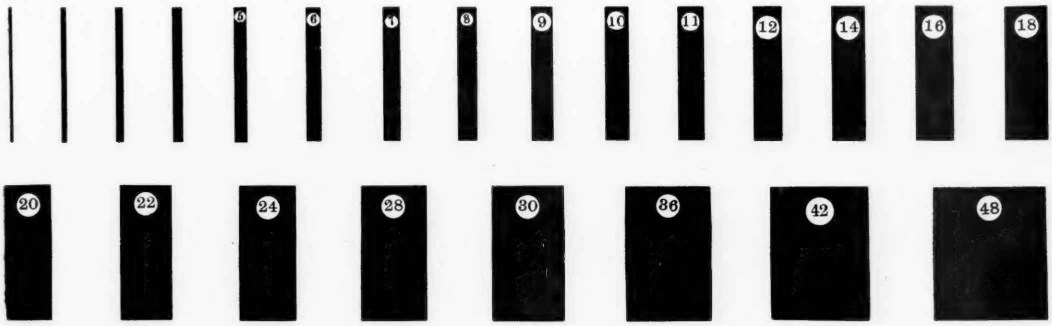
PRINTING FOR BEGINNERS.

FREDERICK A. DRAPER.

II. The Method of Manufacturing Type and the Sizes.

Before considering the selection and handling of type, a brief description of the method of its manufacture will be given. First in the process is the making of the punch, a steel rod upon the end of which is cut the letter, figure, etc., a punch being required for each character in the font. A matrix is then made by driving the punch a short distance into a piece of bar copper, thus forming an indentation of a reverse shape to that of the punch. The matrixes are then used as ties in machines for the casting of type, the matrixes being changed as often as a sufficient number of type have been cast from them. One important peculiarity of type is what is termed the "nick," this being the slot or slots cut on the edge at the lower part of the character. The number and shape of the "nicks" vary with different foundries, and the number and position are changed for different but similar faces of type made by the same foundry, thus forming a very convenient means for distinguishing the font to which a character belongs when distributing type with similar faces.

This important characteristic should be kept in mind when purchasing type, as having a series of fonts of a certain face cast by one foundry, a similar face with a different nick could be purchased of another foundry. This is easily done, as the larger type foundries all cast the more commonly used faces, though sometimes cataloging them under different names. It is more especially helpful to have different nicks upon the small sizes of body type, (the faces used for solid reading matter,) as most job faces are easily distinguished by the shapes peculiar to each face. The nicks also show to the compositor which side should be set uppermost in the composing stick.



SIZES OF TYPE, POINT SYSTEM.

Until recently the sizes of the body or shank of the type were designated by a system which was not uniform with the different foundries, making it a difficult matter to use in the same line type from different foundries. Much time was required for "justifying" or making even the space occupied by the different makes of type. The introduction of what is known as the "point" system has removed this vexatious trouble, all type now manufactured in this country being upon this system. In this system the size formerly known as Pica is divided into 12 parts or points, other sizes being fractional or multiple parts or points of the twelvth part or point thus obtained.

The several sizes of the type body are clearly shown in the illustration, the point number being used in cataloging and ordering rather than the former names, which are also here given.

3 Point Body	Excelsior
3 1-2 ,, ,,	Brilliant
4 ,, ,,	Semi-Brevier
4 1-2 ,, ,,	Diamond
5 ,, ,,	Pearl
5 1-2 ,, ,,	Agate
6 ,, ,,	Nonpariel
7 ,, ,,	Minion
8 ,, ,,	Brevier
9 ,, ,,	Bourgois
10 ,, ,,	Long Primer
11 ,, ,,	Small Pica
12 ,, ,,	Pica
14 ,, ,,	2-line Minion
16 ,, ,,	2-line Brevier
18 ,, ,,	Great Primer
20 ,, ,,	2-line Long Primer

24	,,	,,	2	,,	Pica
30	,,	,,	5	,,	Nonpariel
36	,,	,,	3	,,	Pica
42	,,	,,	7	,,	Nonpariel
48	,,	,,	4	,,	Pica
54	,,	,,	5	,,	Small Pica
60	,,	,,	5	,,	Pica
72	,,	,,	6	,,	Pica

The point system makes it a very easy matter to justify the lines made up of different sizes; two lines of 8-point equalling one line of 16-point; three lines of 8-point equalling one line of 24-point, etc. For that reason, as well as other advantages, it has rapidly replaced type cast on the old body and but little of the latter is now to be found even among dealers in second-hand material. The type here used is 8-point, other body type used in this magazine being 10-point and 6 -point. This designation of sizes applies only to the body, the face or part making the impression, covering the whole or only a part of the body. When only a part of the body is taken up by the face, the unused part is known as the "shoulder" which is variously cast either entirely above or below the face, or with a shoulder both above and below the face. Much of the type now cast is of "Uniform Line", that is, the shoulder is uniform with each of the several sizes, making it possible to set different faces in the same line, and have the whole line even in its impression. In purchasing new type this important advantage should be kept in mind, and preferance given to type so cast. "Lining" type carries the same principle a step further, so that different sizes of type may be set in the same line and present a even line on the lower side. This permits of initial letters, or words which it is desired shall be prominent, being set in larger type than that surrounding it.

The face for one size of type is sometimes cast on the body of the next larger or smaller size, but this is done only to fill the requirements of some particular class of work. With some faces the shapes of some letters are such that a portion overhangs the body, this projection being called a "kern." These are most frequently found in italic and script type; also in some faces of job type, and are to be avoided where possible, as the kerns are easily knocked off in handling, type so injured presenting a poor appearance, as well as requiring more frequent renewal.

Type is sold in case lots of 25 pounds or more, or in fonts for job use, the sizes of fonts varying with the size of the type, and differing with the foundries, each one putting up fonts of sizes which probably seem best adapted to the several faces. The fonts for the smaller sizes of type contains a larger number of each character then do those for the larger sizes. The font "scheme" as the numerical arrangement of the font is termed, is so divided among the characters that the proportions of each will best meet the requirements of average work. It will be found, however, that a few letters are exhausted much in advance of the rest, necessitating the purchase of "sorts," letters are termed which are needed to again fit the case for continued composition. As foundries have a minimum price for a "sorts" order, always make the order large enough to get at pound prices the quantity of type covered by the minimum price. This can easily be done by adding to the order a few letters which are nearly exhausted. The assortment comprised in a 30 A-60 a is here shown. Job fonts are usually packed with the capital letters, punctuation marks and figures in one package, and the small letters or "lower case" in another. Some foundries are now dividing the punctuation marks between the two packages, which is very desirable, as frequently a certain class of work calls for several fonts of lower case but only one font of the capitals.

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CHARACTERS OF 30 A-60 a JOB FONT (HANSEN OLD STYLE, 6 POINT.)

CONTINUED IN THE JANUARY NUMBER.

The Premiums given for new subscribers make good Christmas presents.

HAND SAWS,

THEIR CONSTRUCTION AND USE.

EXTRACTS FROM "HANDBOOK FOB LUMBERMEN," HENRY DISSTON & SONS.

The teeth of a hand-saw should be filed so true that, on holding it up to the eye and looking along its edge, it will show a central groove down which a fine needle will slide freely the entire length; this groove must be angular in shape and equal on each side, or the saw is not filed properly and will not run true.



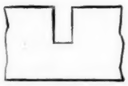
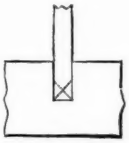

FIG. 4. FIG. 5. FIG. 6. FIG. 7.

Fig. 4 shows how the groove should appear on looking down the edge of the saw; the action should be such that the bottom of kerf will present the appearance as shown in Fig. 5, and not like Fig .6; the cutting action is as shown in Fig. 7; the cutting being done with the outside of tooth, the fibre of the wood is severed in the two places and the wood is crumbled out from point to point by the thrust of saw.

The proper amount of bevel to give the teeth is very important, as is demonstrated by the above figures, for if too much bevel is given, the points will score so deeply that the fibres severed from the main body willnot crumble out as severed, but be removed by continued rasping. particularly in hard woods, as they require less bevel, as well as pitch, than soft wood.

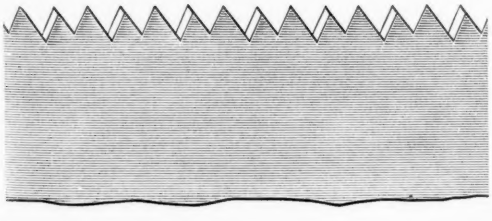

FIG. 8.

Fig. 8 shows a six-point cross-cut saw filed with a medium amount of bevel on front or face of tooth, and none on the back. This tooth is used in buck-saws, on hard wood, and for general sawing of woods of varying degrees of tenacity. This style of dressing is the best, but a number of saws each having teeth suited to its particular work, will be found more advantageous than trying to make one saw serve for all kinds of hand saw work.

We will now consider the cross-cut saw tooth, in regard to rake or pitch; this being one of the most important features, too much care cannot be taken to have the correct amount of pitch for the duty required. To illustrate this, Fig. 9 represents a board, across which we wish to make a deep mark or score with the point of a knife; suppose we hold the knife nearly perpendicular as at *B*, it is evident it will push harder and will not cut as smoothly as if it was inclined forward

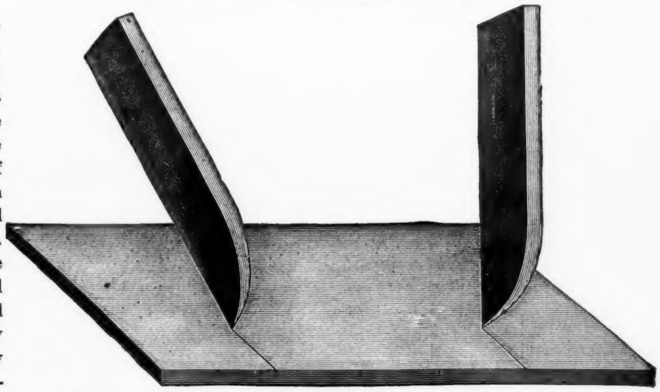

FIG. 9.

as at *A*; it follows then that the cutting edge of a cross-cut saw should incline forward as at *C*, rather than stand perpendicular as at *D*.

Too much hook or pitch, and too heavy a set are very common faults, not only detrimental to good work but ruinous to the saw; the first by having a large amount of pitch, the saw takes hold so keenly that frequently it "*hangs up*" suddenly in the thrust—the result, a kinked or broken blade; the second, by having too much set, the strain caused by the additional and unnecessary amount of set is out of proportion to the strength of the blade, and is broken in the same manner. The most general amount of pitch used is 60°, though this may be varied a little more or less to advantage, as occasion may demand.

The next point to be considered is the bevel, or fleam, of the point. In Figs. 10, 11 and 12, the filer, as

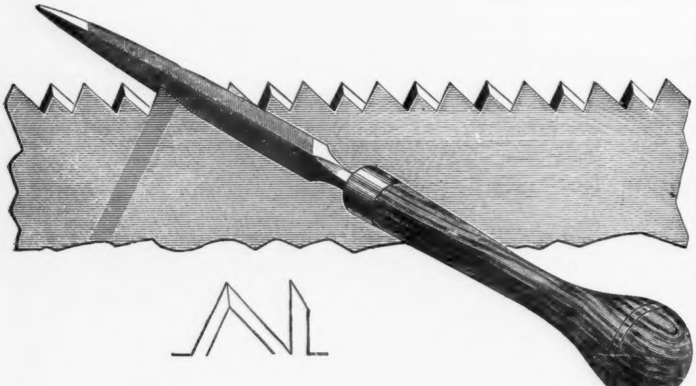

FIG. 10.

in all cases, files from the heel to the point, which is the only correct way. The file is supposed to be horizontal to the perpendicular of the side of saw, and on an angle of about 45° longitudinally with the length, measuring from file line toward heel.

Fig. 10 is a five and a half cross -cut saw showing the same amount of fleam front and back ; this saw is best suited for workin soft wood, and where rapid, rather than fine work is required. *A* shows the position of the file, *B* an exaggerated view of shape of point, and *C* the shape of point.

Fig. 11 is a seven point saw for medium hard woods, illustrated in same manner as Fig. 10. This tooth has less fleam on the back, which gives a shorter bevel to point, as at *C*. Fig. 12 is a still finer saw, having ten points to theinch. This saw has no fleam on back, the result being very noticable at *C* and *B*. Thisstyle of point is for hard wood.

It will be seen that the bevel on the front of teeth in Figs. 10, 11 and 12 is the same, but the bevel of the point looking the length of saw is quite different, consequent upon the difference in the angles of the backs.

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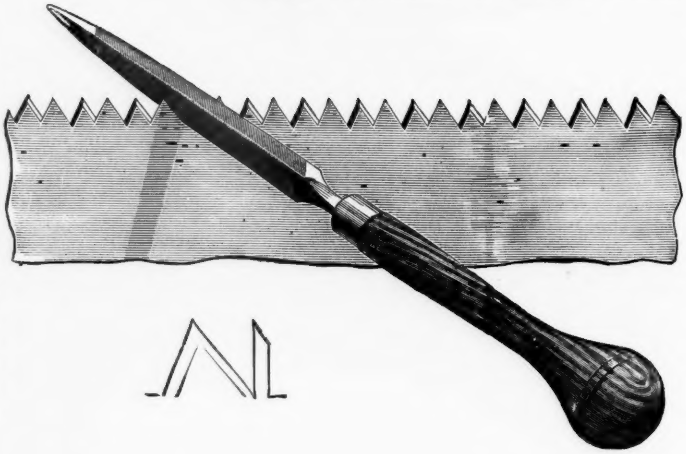


FIG. 11.

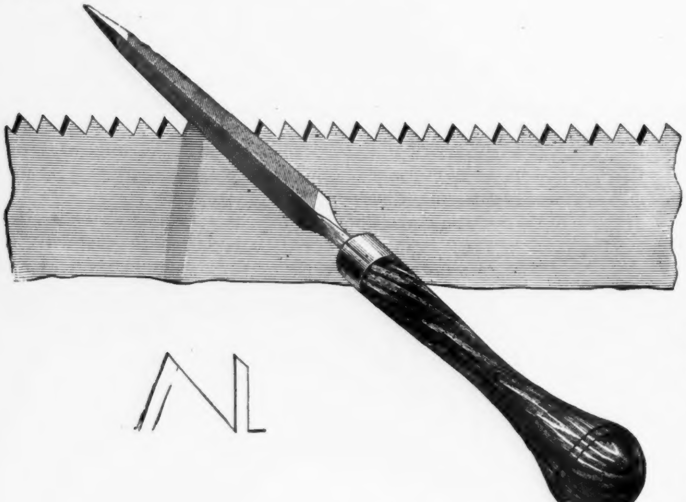


FIG. 12.

The wood used in lead-pencil making must be close and straight-grained, soft so that it can readily be whittled, and capable of taking a good polish. No better wood has been found than the red cedar, a native of the United States, a durable compact, and fragrant wood, which today is used almost exclusively by pencil makers the world oAer. The best quality is obtained from the southern states, Florida and Alabama in particular.

The Correspondence Column is omitted from this number owing to lack of space.

JUNIOR DEPARTMENT

For the Instruction and Information of Younger Readers.

INDUCTION COIL EXPERIMENTS FOR BEGINNERS.

I do not think it need be supposed that even an amateur will buy or make a 4″ or 6″ coil, without having some set purpose in view, or a good idea of the uses to which he intends to put the induction coil

There are many amateurs who build or buy coils, giving a spark ranging from 1-4″ to 1″ with very little notion of the possibilities of such coils, and it is for these readers that I describe the following simple experiments :— A small coil experiment, which is one of the most striking and often the only one which beginners perform for the edification of themselves and friends, is a display of vacuum tubes. Current from the secondary of a 1-4″ spark coil will light up tubes 6″ or 8″ long; but the best effects are obtained from a little larger coil than this. It may, perhaps, be better to explain here that in all experiments with high tension electricity the operator must be most particular not to be included in the path of discharge, or the result may be harmful.

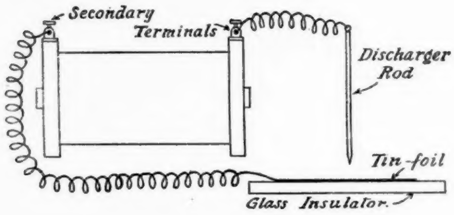


FIG. 1.

A very fine experiment with a small vacuum tube and say a 1-4″ spark coil, is the following :—Put the coil in action, discharging sparks as usual. Take a vacuum tube in one hand, and place the loop at the end in contact with the positive discharge rod; then gradually bring the index finger of the other hand towards the other discharger rod terminal; but *on no account* touch it, and the tube will be seen to be lighted up, Another variation with these Geissler tubes is to fasten them securely in a vacuum tube rotator. Current is conveyed to the tube while the rotator is in action, giving the effect of a wheel of light. Do not use small tubes with large coils giving over 1″ spark unless the platinum electrodes are very thick; but tubes of more than 6″ are fairly safe on larger coils, though no definite rules can be given.

Here are a few of the more interesting experiments with the spark itself. Place a sheet of tinfoil, or a piece of glass, in contact with one of the secondary terminals. Bend a short length of wire attached to the other terminal until it is within striking distance of the tinfoil plate (Fig. 1.) Set the coil in action, and you will see the stream of sparks break into several little rays and wind across the tinfoil. This class of experiment is very numerous, and the amateur, when once started, will have much enjoyment from experimenting with the spark itself. Defiagration experiments are easy. Get two short lengths of iron wire, and put one in each end of the discharging rods. Arrange the distance between so that the iron becomes white hot when the coil is in use. Bright sparks will be emitted from the white hot metal. Try this with different metals, and notice the difference in the color with using different wires. Let the spark pass through fine metal filings placed on an insulator. Some of the filings will be fired by the spark, and the latter in its zig-zag path will be colored according to whatever metal was used. Tip each discharger point with a little oil, and bring them very close together. The spark will be a vivid green. Lycopodium powder on cotton wool, if placed in the way of the spark, is fired; and the same thing can be done with gunpowder in very small quantities.

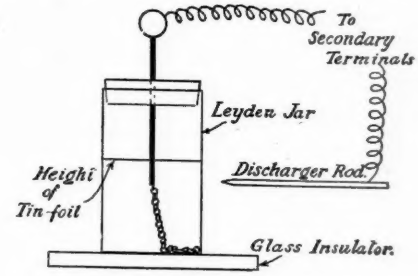


FIG. 2.

These will no doubt serve to start the amateur on the road to discovering many more such experiments for himself. All experiments performable with a Wimshurst machine can be done on an induction coil. Firstly, I will show how to charge a Leyden jar from a coil. Put the jar on a piece of glass, or similarly good insulator (Fig. 2.) Connect the knob of the jar to one of the discharger points, and let the other point be held at a little distance from the outer covering of the jar. When the coil is put in action a static charge of elec-

tricity will be given to the jar. This leads us to another little variation. Set the coil ready for sparking, and in addition, attach a wire from one terminal of the secondary to the knob of the jar, and a wire from the other terminal to the outer covering. When the coil is discharging sparks, the jar receives a static charge, and forming as it does an extra condenser, it

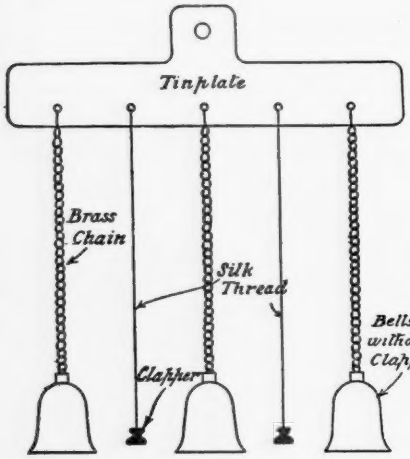


FIG. 3

discharges itself across the spark-gap together with the ordinary coil discharge. The length of the spark is thus increased.

The following is an experiment known as the "Chimes," the construction of which is shown in Fig. 3. The centre bell is connected to the ground by a

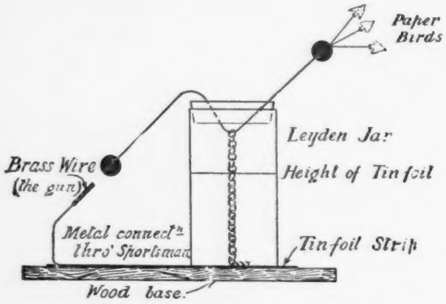


FIG. 4.

chain from its centre touching the table. When a charge is given this apparatus, the clappers are attracted to the outer bells, which are charged with electricity. When the clappers touch, they too are charged, and are repelled with enough force to enable them to both strike the centre bell. This discharges them again, and the movement is repeated.

Another may be styled the "Birds and Sportsman" experiment. On a small base is erected a Leyden jar of the kind I have depicted. A strip of tinfoil is fastened along the baseboard, and the jar rests on this (Fig. 4.) The birds are of paper, and fastened to one brass ball with a piece of thin cotton. The sportsman's gun is a piece of brass wire, and is connected with the tinfoil on the base. The gun points to the other brass ball. When the jar is charged the birds will fly apart by repulsion, and remain flying for a short time. Now gradually push the sportsman nearer until his gun is very near the ball. This will discharge the jar with a loud crack, and the birds will fall. Finally, I think every amateur electrician will find that there is hardly any other instrument which he will obtain that will give such lasting pleasure as an induction coil.

Model Engineer, London.

HANDY RECEIPTS.

TO CLEAN LENSES.

Clean lenses as rarely as possible. Use old linen or a very soft chamois skin, but never use silk. If greasy, wet with a weak solution of cooking soda, and wipe dry with the cloth or chamois.

FLEMISH OR DARK OAK STAIN.

First stain the wood with any thin black stain; the following being easily made: —Sulphate of iron, 2 oz. extract of logwood, 1-2 lb. carbonate of iron, 1 oz. vinegar, 1 quart. Boil over a slow fire for two or three hours and strain through a cloth. Then apply a coat of antique oak stain, made as follows : — Raw sienna is thinned with linseed oil and turpentine to the right consistency for the depth of color desired. Ivory black may be added if a very dark stain is wanted. If a filler is needed, use oak filler.

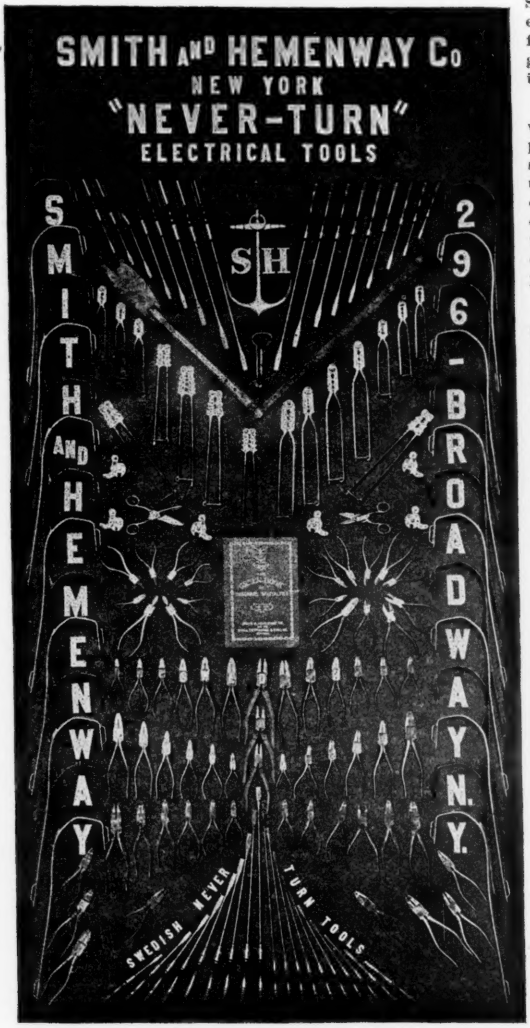
WATERPROOFING SHOES.

Castor oil, well rubbed into the soles, seams and uppers of shoes will prevent to a large extent moisture from rain or snow from working through, and allow shoes to be polished with blacking. It is well however, to polish with blacking before applying the oil. Preparations with gums such as copal, eventually harden and cause cracks.

Prof. Alexander Graham Bell recently gave a correspondent of the *Daily Telegraph* an idea of his work on the problem of aerial flight. He has spent years in study, and many thousands of dollars, in the effort to invent a means of flying, When asked if he thought that man would ever be able to fly, the professor replied: "I can see no reason why anyone who has noted the flight of birds can for one moment doubt the possibility of flight by bodies specifically heavier than the air."

TRADE NOTES

The well-known hardware specialty house, Smith & Hemenway Company and Utica Drop Forge & Tool Co., of 296 Broadway, N. Y., publishers of the Green Book of Hardware Specialities, a catalog so well known that little more need be written of it, have sub-divided this book into four sections, uniquely and attractively printed on a green French folio paper. These sections, "Glaziers," "Electrical," „ Rasor" and "Castor" were printed in compliance with the request of many customers, to get up a catalog small enough to be conveniently carried in the pocket.



The progressive firm is ever on the alert for an attractive catchiness in their advertising, and in these sub-divisions of their Green Book of Hardware Specialties have gotten out something that is not only attractive but useful, and the light weight of paper on which they are printed makes them fit so snugly in the pocket that they can be always carried, and constantly used for reference.

The Reid chucks, manufactured by R. H. Brown & Co., New Haven, Conn., has exceptional merit. It holds drills both accurately and firmly, two points which every mechanic will appreciate. For use by amateurs, it is just the thing. Send for descriptive circular.

The set of small taps and dies in morocco case, put out by the Morse Twist Drill & Machine Co., New Bedford, Mass., is one which more than pleases every purchaser. For model makers it is just the thing, and should be looked up by all readers interested in machine work.

A most convenient circular lately issued by Hammacher, Schlemmer & Co. Bowery, New York City, lists the many different catalogues issued by this firm. Every amateur should send for it, and the catalogues of the tools of interest to them, as they give much valuable information, and afford buyers an opportunity of supplying their needs at most reasonable prices.

The merits of correspondence instruction have now become so well recognized, as to require no extended mention, but their personal application to readers of this magazine cannot be too strongly emphasized. If more thought was given to a profitable use of spare time, and the advantages to be gained by persuing a course in such a school, the resulting benefit would eventually cause one to wonder why the start had not been earlier. Write the International Correspondence School, Scranton, Pa., for catalogue of courses, and see if some of them would not advance your prospects in both a business and intellectual way.

The Atkins saw is so well known throughout the country for its fine qualities, that no mention of them is necessary, other than to state that the discrimnating buyer who selects this brand is always satisfied with the work it will do. They are used in Manual Training schools in many parts of the country, so many readers are favorably acquainted with them.

The latest catalog of Carlisle & Finch, Cincinnati, Ohio, shows the new sizes of gas engines, new models in electric railways and other novelties which many of the readers of this magazine are interested in, and should be obtained at an early date. Those who are looking up Christmas gifts should certainly have this catalog.

The H. R. S. motors and dynamos are of most modern design, well made and finished, and just the thing for small work. Those who have purchased them are much pleased with the work obtained from them. Write H. R. Swope, Philadelphia, Pa.

Those building the power dory should remember that the author recommends magneto igniter for generating sparks. Those made by Kendrick & Davis, Lebanon, N. H. posses exceptional merit, are enclosed and moisture proof, and will furnish plently of strong, fat sparks making ignition sure. A descriptive circular will be mailed to any address.

The Rich handy drawing outfit is what every engineer and draftsman should posses. An illustrated circular is sent upon request, and readers are cordially recommended to send for it, as it gives a good idea of the usefulness of this excellent outfit. Address J. & G. Rich, 120 N. 6th St. Philadelphia, Pa.

A well made screw-driver firmly handled, so as not to work loose after a little use; blades forged from the best cast steel and well finished, is the only kind which will give satisfaction to the user. Those made by the H. H. Mayhew Co., Shelburne Falls, Mass., are of this kind, and sold at a price which is also satisfactory. Other tools of equally good quality, and much used by amateurs, are shown in their catalogue which will be mailed upon request.

The F. E. Reed Co., Worcester, Mass., manufacturers of machine tools, are constantly increasing the number of educational instutions which are users of their machines. This is quite what might be expected, as this firm give the most careful study and attention to the special needs in such tools, and consequently produce what will give the greatest satisfaction to purchasers.